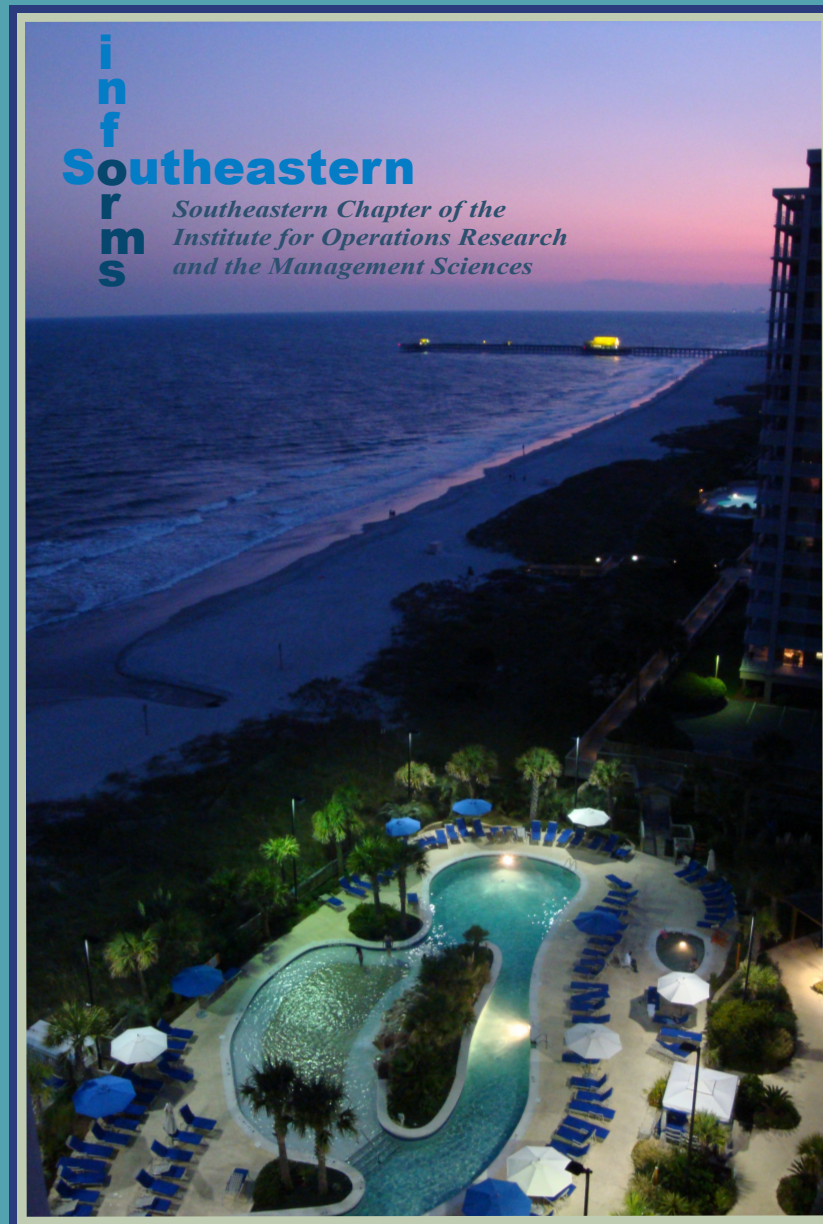


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TEACHING ACCOUNTING AND OTHER BUSINESS COURSES TOTALLY AND PARTIALLY ONLINE

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ABSTRACT

This paper summarizes the state of key issues affecting non-traditional delivery systems in the United States, especially for those educational scenarios where students are generally computer prolific and regularly use laptop computers for both traditional and online courses. The paper also describes preliminary results of a study in two Principles of Financial Accounting courses—one with traditional face-to-face seat time and the other with a one-third reduction of in contact class time. Findings include that the partially online section earned stronger grades at the end of the semester, but did suffer with slightly greater attrition. The hybrid section earned higher grades even though they were taking a larger semester hour load. The traditional class section was able to improve final grade average since the midterm, but was unable to catch up to the achievements of the partially online section at the conclusion of the course. However, the number of withdrawals from the traditional section were less than the online section, suggesting if attrition is an important objective, traditional mainstreaming with full course meeting times is desirable.

INTRODUCTION

The tremendous growth in recent year of totally or partially "hybrid" online courses in colleges and universities suggests that this form of distance learning is not a passing fad but an educational phenomenon that is permanent and increasing. In fact, some programs in both nontraditional--and traditional university settings are totally online. For example online MBA programs are offered at both the nontraditional University of Phoenix and the very traditional Auburn University. Other universities such as Brandman University, a member of the Chapman University system headquartered in Orange, California, offers undergraduate and graduate programs favoring a "hybrid" approach with both face-to-face traditional classroom teaching as well as a strong online component. Another example of a university where the hybrid partially online approach is favored over the totally online mode is Clayton State University in metro Atlanta, Georgia where some business courses, especially those with a class schedule of Monday/Wednesday/Friday, are offered in the hybrid format.

TRADITIONAL VERSUS ONLINE

The number of online course offerings in business courses continue to increase. Courses with a significant online presence are popular with both university administrators and students--both the younger traditional students and older adult learners. Increased student enrollment eases some concerns by budget-conscious administrations. Most younger traditional students are very comfortable with technology, especially the "Millennials" born between approximately 1983 and 1996, also called "Generation Y" or "Echo Boomers" who have been growing up using technology from an early age. Students of all ages like the flexibility in both location and time. With rising fuel costs, heavy traffic, and increasing work commitments often requiring travel, non traditional adult students also often prefer the advantages of the online format. They often use technology in their workplace and are familiar with it. Another advantage of the online approach is noted by Machuca (2007) who studied online teaching methodologies and found that online learning provides more customized and individual instruction for students with different learning needs and styles, as well as provide adult learners with greater opportunity to gain insight and knowledge through a variety of instructional media.

Another point is that exposure to online learning prepares students for their future careers. For example in the accounting profession the prestigious Certified Public Accounting (CPA) designation requires passing a rigorous examination that in recent years has become increasingly technology-based, with some parts simulating online research that would be done by an accounting professional in today's online accounting environment. Accounting records of companies are maintained, and financial statements are prepared with the utilization of accounting software. Recently the thousands of pages of "Generally Accepted Accounting Principles" have been organized into the online "Codification" used by accounting and auditing professionals. Tax practitioners have used computer-based and online resources for many years. All accounting professionals face opportunities to purchase diverse software packages from vendors, and the larger firms engage in a substantial amount of internal development.

The advantages of online learning as preparation for the modern work environment has been suggested by Borthick and Jones (2000) who note that the online approach to learning prepares students for work environments in which new problems are the norm and professionals work collaboratively to solve them in virtual space. These authors make a case for a master's course in information systems assurance, valuable to future professional accountant auditors, being more effective than a traditional lecture-based course because of its use of collaborative discovery learning online. Borthick and Jones hold that when learning participants are immersed in a community of practice and solve problems collaboratively together, these online participants seek the knowledge they need and solve problems together in a virtual environment. The authors point out other advantages such as accessibility because participants may be anywhere they have Internet access, and affordability as the development and delivery efforts are leveraged across multiple universities.

In thinking of the challenges of business education, more advantages of online learning become apparent. Increasingly there has been a focus on the importance of global business including international issues in education. It is interesting that one of the two International Education Practice Statements (IEPS) released by the International Accounting Education Standards Board (2007) focuses on an information technology (IT) knowledge component of a professional accounting education program in outlining the knowledge and skills necessary to prepare professional accountants to perform competently in the IT environment. According to IEPS 2, all professional accounting candidates are expected to have knowledge and understanding of at least one of three roles--manager, evaluator or designer of information systems--or a combination of these roles.

Since online or at least partially online classes appear to be desirable for a number of reasons, an important question has arisen regarding whether or not online classes are as effective as traditional face-to-face courses. Many of the earlier research studies have not found significant differences. Salimi (2007) recounts a 1999 study by Thomas Russell entitled "The No Significant Difference Phenomenon" in which the author examined 355 studies comparing distance education to traditional education, and found that many studies supported the view that there is no significant difference between the two modes of instruction. Some subsequent studies have tended to deliver similar results.

For example Gagne and Shepherd (2001) studied the differences between an introductory graduate accounting class delivered according to traditional method versus through distance learning. The authors findings supported prior research in that the performance of students in the online course was similar to the performance of students in the on-campus course. Gagne and Shepherd also found that students' evaluations of the course were similar, although students in the online class were less satisfied with instructor availability than the in-class students, and the authors suggested that future research in this area should focus on improving student perception of instructor availability, for example by videos or improving students' perceptions of instructor availability, and also to study whether some student subjects are more prone to this student perception problem than others.

Basile and D'Aquila (2002) found no significant differences in performance results between students using WebCT course management software and students studying with traditional instruction methods. Friday, Friday-Stroud, Green and Hill (2006) conducted a multi-semester (eight semesters), multi-course study comparing student performance in undergraduate online and traditional sections of strategic management courses, and similar to previous research studies, found no statistically significant

differences in student performance between online and traditional classes. Mallory (2007) compared three classes of students enrolled in a traditional Principles of Accounting course to their distance learning counterparts. The traditional and online students were taught by the same instructor and provided with the same learning material, as well as given equal access to the instructor outside of class. The author found no significant differences in final course grades or in attrition rate, although there was a significant difference in the self-reported behavior types between the online and traditional students. However academic socialization did not appear to be of concern to the online students. Larson-Birney (2000) studied Internet based and traditional deliveries of an introductory accounting course, and found that the final exam grades and final course grades were very similar between the two groups. However the withdrawal rate was almost three times higher in the Internet class.

Other authors (Huh, Jin, Lee and Yoo, 2009) have studied the differential effects of student characteristics on performance as measured by test scores between online courses and offline courses in undergraduate accounting at California State University, San Bernardino. Student characteristics variables included GPA, age, commuting distance, working hours, gender and marital status. While overall empirical results suggest no significant differences in student performances, some characteristics variables were found to have differential effects on performance between students in the online and traditional courses, with the effects of GPA and gender on performances being significantly higher for offline students than for online students.

In another interesting study, Stapleton, Wen, Starrett, and Kilburn (2007) investigated generational differences in using online learning systems, examining factors of perceived satisfaction, perceived learning, online technology environment, interaction, student motivation and self-management. In analyzing 966 usable responses, a number of generational differences were found. Millennials have more interaction with students, have less interaction with instructors, are more comfortable with online course discussions, and are less likely to have an online learning plan. However contrary to profiles of generations in the literature, the results suggested that the perceived satisfaction, learning, and motivation of these generations are more homogeneous than different. Nellen, Manly, and Thomas (2009) also studied accounting education and the Millennials. Based on their unique characteristics, the authors suggested specific teaching techniques to better engage these students. For example, since Millennials are comfortable with and know how to use technology, to better engage these tech savvy students in the learning process, instructors would be wise to make use of technology where appropriate, including PowerPoint, course-management software, pod casts, and Internet resources, and in addition should respond quickly to e-mail or IM questions.

Student perception of online courses has stimulated research. Watters, and Robertson (2009) who taught introductory undergraduate, upper-division undergraduate and graduate accounting courses in an online format found that approximately 75% of the undergraduate students indicated that online delivery of the courses was as effective or more effective than a traditional course. Watters and Robertson also found that all of the students in the graduate course agreed that the online course delivery was as effective as a traditional course, and furthermore that in the future they would prefer to take more online courses as compared to traditional courses. However less than one-half of the combined students in the two undergraduate classes indicated that in the future they would prefer to take more online courses, compared with traditional courses. The authors noted that in the case of the course they studied, that the online delivery was probably more appropriate for the graduate class.

A CALL FOR THE HYBRID DELIVERY

It seems reasonable that preference of Millennials for technology may indicate a preference for online delivery--whether totally online or in the partially online hybrid form. However as indicated by the above authors, it may be that certain courses, particularly undergraduate course in such disciplines as accounting, may best be suited for the partially online hybrid approach. Dowling, Godfrey and Gyles (2003) investigated the association between the learning outcomes of students and the two teaching models of a traditional face-to-face model and the hybrid flexible delivery model. The hybrid model

was delivered using a combination of face-to-face and electronic delivery and communication tools. The authors found that academic performance is higher for students who studied under the hybrid flexible delivery model, achieved higher marks in prerequisite units, were female, or were younger. The authors provide evidence that the hybrid method can be used to achieve the benefits of small class sizes when teaching large numbers of students--results of interest to administrators interested in supplying education to increasing numbers of students and meeting flexible delivery schedules.

AN INFORMAL EXPERIMENT WITH HYBRID

The authors of this paper have over sixty combined years of teaching Accounting Principles courses. Our Institution is known as a laptop university where all students must have available in and outside of class a compliant laptop computer. Accordingly, as we designed our study, we needed to be sensitive to the equal accessibility to the technology by all students—both traditional and partially online. Furthermore, we are unable to control for the technology effects studied by Basile and D'Aquila (2002). While our Institution was an early leader in online course development, we backed off in recent years on full scale online courses in our accounting curriculum.

However, partially online courses are tried periodically in the undergraduate curriculum for managerial cost, income tax, and intermediate accounting. The parameters on a partially online class typically are contact time between student and professor in class at approximately 40 to 60% of the traditional class with conventional seat time. Our efforts in these courses have yielded mixed results. Faculty teaching these courses did enjoy the ease of attending conferences and professional meetings resulting from less structured mandatory seat time, but because each of these courses is an entry point into the accounting major at the junior year, and due to the ability to offer only one course of each class each semester, we have not been able to measure true success with the hybrid delivery structure.

During the Fall, 2009 semester, we devised a way to measure hybrid teaching and learning effectiveness. By using the standard Principles of Financial Accounting course, required of all majors in the School of Business and some allied Schools, we were able to counteract both the control and the rigor problem. Control was achieved by measuring the results of one instructor who simultaneously taught a traditional and a hybrid section in the same semester. While the accounting principles courses are substantially rigorous for many students, the authors believed that type of rigor was one we could control for through sufficiently large class sizes.

A continuous concern by the authors as well as our administration, is not to deprive any student tools which could assist them in path to success. While making all the electronic tools equally available to the traditional and hybrid sections, we do not believe we jeopardized relevance of our results. Rao and Walsh (2000) recommended “chat” discussion board activities by students, and this is a practice that is heavily engrained with many of our students. Accordingly, we did not want to withhold the technology applications from any student. Kozub (2010) reports that supplemental online resources anyway are not viewed by students as substitute for class attendance ,and that the availability of the resources does not enhance grade performance in undergraduate financial accounting.

Figure 1 shows the results in terms of class GPA (A=4.0) of the sections under study

FIGURE 1. COMPARATIVE COURSE GRADES

Delivery Style	Original Class Size	Number of Withdrawals	Percent With-drawals	Students Completing Course	Midterm Course GPA	Final Course GPA
Traditional	55	7	12.7%	48	2.04	2.29
Hybrid	52	11	21.2%	41	2.73	2.55

To assist with possible future policy directions regarding student advisement, we also sought to the academic measures of Overall GPA. A suspected distraction from doing high level work is overall course load so we decided to factor that in as well. Figure 2 carries these results.

FIGURE 2. COMPARATIVE TOTAL SEMESTER HOURS AND OVERALL GPA

Delivery Style	Sample Size	Total Semester Hours	Overall GPA
Traditional	48	10.73	2.73
Hybrid	41	12.34	2.57

Preliminary analysis of data between the traditional and hybrid showed significance in course grade, which was higher for the hybrid section. The difference in total semester hours was also significant, with hybrid taking a larger semester course load than the traditional group. However the difference in overall GPA between the two groups was insignificant.

CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Our preliminary findings reveal that some students do tend to perform better under the hybrid rather than the traditional delivery method. This is so even though students in the hybrid group were taking more semester hours.

We held constant as many variables as possible between the two sections, except for the number of meeting times. The instructor's office hours and Blackboard Web platform were identical as were the type and quality of assessments.

We realize that earlier studies focused on age, gender, and other variables. We plan to explore these characteristics in future research. One limitation that we plan to control for in the future is the timing during the day when classes do meet. We suspect that differences will be revealed in morning, afternoon, and evening sections.

We are delighted to see positive results in the overall final grade for the hybrid section. However, the deterioration in the grade (or further lack of progress) since the midterm, and the larger number of withdrawals, may be indicative that the achieving students rest on their laurels and coast the second part of the semester, once learning the ropes of the hybrid delivery, and that traditional students will on the other hand come to the plate with determination and complete the course with satisfactory results.

We make no claims at this time about external validity. While students are notified in advance of which section is hybrid, that may mean little to some students who are just looking for a satisfactory grade with minimal preparation. The hybrid section under study met only two-thirds of the regular class time, with Friday being the normal “non-meet” day. Both the hybrid and traditional section met most Mondays and Wednesdays.

The results indicate that the hybrid class actually performed better in terms of grade point average. However it is interesting to note that the number of withdrawals in the hybrid section was greater than in the online section. Although the hybrid format may have influenced the withdrawal rate, It should also be noted that the hybrid section was a day section whereas the traditional section was an evening section. Thus it may be that the differences in performance were due to other factors including demographics of students, and the necessity of future research is acknowledged. Future research is also needed to compare the hybrid approach to the totally online delivery mode.

The authors hope to include in their future research the issue of faculty development to improve online delivery. It is interesting to note that some institutions require faculty to complete an online training program before teaching online courses. The benefits of this approach have been suggested in prior research. For example, Lavoie and Rosman (2007) describe how the Resource-Enriched Learning Model (RELM), an active student-centered approach to faculty development and course design and delivery provides faculty with the skill set learned in the same environment that they will create for their students. When faculty experience active learning firsthand in an online environment they become better prepared to create a similar learning environment for their students. Salimi (2007) discusses how teachers need to be trained not only in the technology of online teaching, but in designing online education courses as well. He notes that some universities such as the University of Maryland require their online instructors to successfully complete a thorough training program before they are allowed to teach online courses, but in many other schools the resources to train faculty to teach online are not enough and instructors are left to flounder around on their own in developing their online courses. Salimi also points out that it takes much longer to set up an online course than a traditional course, and that there needs to be adequate compensation such as release time given to faculty for this purpose.

In summary, future research is needed in a number of different aspects of online learning, including issues from the students perspectives and also from the faculty perspective. Important issue for future work include study of the effectiveness in meeting learning outcomes, differences between online and traditional face-to-face instruction, and differences between the totally online and partially online hybrid approach. It is hoped that presentation at the SEINFORMS Conference will provide an opportunity for colleagues to share best practices and experiences in teaching online business courses.

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GOING CONCERN AND MANAGEMENT PLANS: MANAGEMENT OR AUDITOR BURDEN?

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ABSTRACT

This paper covers the argumentation for and against increased management reporting and disclosure requirements relating to the accounting issues of a “Going Concern” and the “Management Plans” associated with addressing the assessment. A long outstanding Exposure Draft (proposed Statement) on Going Concern still waits passage into the Accounting Standards Codification. The paper points to the relative burden placed on both the entity’s management and the accounting firm performing the audit. The increased involvement will not come without cost. This paper describes the burden that lies ahead for the accounting profession, both inside and outside of the entity being audited.

INTRODUCTION

In October, 2008, the Financial Accounting Standards Board issued two companion Exposure Drafts (ED) which contained disclosure information requirements by management and concerned time line reporting issues—Subsequent Events and Going Concern. The interesting parallel is that both of these proposed standards dealt with a download from the auditing literature into the financial reporting literature. While the proposed standard on subsequent events has been approved and elevated to authoritative generally accepted accounting principles (GAAP) through codification in the Accounting Standards Codification, going concern financial reporting and disclosure continues to be nonauthoritative. This paper addresses the key issues involved in the dilemma between management issuers, auditors, and the users of financial statement information. The paper does not conclusively defend any particular position, but rather extrapolates to other areas of the accounting and auditing literature where controversies exist, and where convergence is not easily resolved.

From the vantage point of practice, firms are pointing out that the going concern assertion is one of the most fundamental in financial reporting, and accordingly represents one of the most critical assertions considered by users of financial statements, Ernst & Young (2008). A strict downloading of the language from the SAS into the FASB Codification may backfire as pointed out by McGladrey & Pullen (2008): Paragraph 6 of the Exposure Draft reads, in part, that management’s consideration relating to its plans may include...Plans to reduce or delay expenditures or increase ownership equity include “apparent feasibility of plans...” The usage of the term “apparent” may be appropriate for the auditor, but for management of the reporting entity, another modifier would make more sense.

THE AUDITING AND FINANCIAL REPORTING LITERATURE

There has been little direct guidance historically on the issues of management’s reporting on its own entity’s ability to continue as a going concern. Much of the general knowledge in this area stems from Statement on Auditing Standards (SAS) No. 59, *The Auditor’s Consideration on an Entity’s Ability to Continue as a Going Concern*, Auditing Standards Board (1988). Embedded within this document are the requirements that the auditor assesses what management reports, presumably by means of footnote disclosure in the financial statements, or in the case of publicly held entities, in one of the other filing

documents. Further implied is the disclosure by management of its plans to ameliorate the going concern issue(s).

Succinct summaries of the workability of SAS No. 59 are provided by Goldstein (1989) and by Behn, Pany, and Riley (1999). The integration of corporate governance and how management plans are drafted to be case specific are found in Behn, Kaplan, and Krumwiede (2001), and in Parker, Peters, and Turetsky (2005).

The Financial Accounting Standards Board (2008) Exposure Draft on going concern contains the disclosure requirements shown in Figure 1. If approved and ratified for the Codification, the location would be 205-30-50-1.

Figure 1. Going Concern Disclosures

50-1	When management is aware, in making its assessment, of material uncertainties about events or conditions that may cast substantial doubt upon the entity's ability to continue as a going concern, the entity shall disclose those uncertainties. In particular, the entity shall disclose information that enables users of the financial statements to understand:
a.	Pertinent conditions and events giving rise to the assessment of substantial doubt about the entity's ability to continue as a going concern
b.	The possible effects of those conditions and events
c.	Management's evaluation of the significance of those conditions and events and any mitigating factors
d.	Possible discontinuance of operations
e.	Management's plans to mitigate the effect of the uncertainties and whether management's plans alleviate the substantial doubt about its ability to continue as a going concern
f.	Information about the recoverability or classification of recorded asset amounts or the amounts or classification of liabilities.

Because the auditing literature preceded the current attempt for requiring management's assessment of going concern in the financial accounting and reporting literature, problems emerge in juxtaposition between management's assertions and the auditor's assessment. Ellingsen, Pany, and Fagan (1989) wrote immediately following the issuance of the SAS No. 59 that there is no requirement to make auditors responsible for predicting future events, nor is there any requirement generally for auditors to perform more procedures than they previously had done. Should management be subject to predicting future events? Should the scope of the audit work now be expanded in view of the expanded responsibility by management?

KEY PROBLEM AREAS

Definitions and Intent of Good Reporting

Grant Thornton (2008) notes that the proposed Statement refers to a "going concern" but is silent in defining the term, and that the term is also not defined anywhere in the Codification, nor in any other existing accounting guidance. The proposed standard fails to provide a clear definition of what is a going concern; it provides an example of what it is not by analogy by not meeting current debt obligations.

Under such general presumption, virtually all start-up enterprises would be subject to a going concern as such entities are dependent upon possible future subsequent operational, investing, and financing success. Little of this can be quantified by management, and even less attested to by the auditors.

Is it necessary to have more of a trickle down into small and medium size enterprises? Widely-helds already are required by the SEC to disclose “risk factors,” include comments in their “M,D,&A”. All companies must meet the requirements for contingent liabilities and fair value accounting.

Deloitte (2008) states that the language applied in the companion Exposure Draft on subsequent events of “available to be issued” is far more reasonable than longer time lines. Accordingly, a period not to exceed 12 months from the balance sheet date, and on the basis of conditions and events that exist at or have occurred before the date the financial statements are issued or available to be issued, is easily captured.

“Bright-Line” Time Issues

One of the Exposure Draft’s specific questions was “. . .the Board decided to adopt the time horizon in IAS 1 (at least, but not limited to, twelve months from the end of the reporting period), instead of the time horizon considered in AU Section 341 (not to exceed one year beyond the date of the financial statements). The Board decided to use the time horizon in IAS 1 because it avoids the inherent problems that a bright-line time horizon would create for events or conditions occurring just beyond the one-year time horizon that are significant and most likely would have to be disclosed. It also would result in a convergent approach between U.S. generally accepted accounting principles and IFRS. Do you agree with the Board’s decision to remove the bright-line time horizon in AU Section 341 I favor of the guidance in IAS 1? If not, why? Do you believe that this time horizon is helpful and operational? If not, why?” The issue then becomes—would the IAS 1 time horizon provide a higher degree of comfort to the financial statement users for going concern issues?

The New York State Society of CPAs (NYSSCPA) (2008) further argues against a long time line exceeding one year, as FASB Statement No. 6, *Classification of Short-Term Obligations Expected to be Refinanced*, applies the one-year guidance. The Technical Issues Committee of Private Companies Practice Section (PCPS) of the AICPA (2008) notes its support for management to carry the primary responsibility for assessing the ongoing viability of the reporting entity, though the indefinite time horizon for management’s assessment in turn lengthens the assessment period that the auditor must evaluate.

PriceWaterhouseCoopers (2008) voiced concern that the requirement that management take into account “all available information about the future,” coupled with an open-ended time horizon, imposes an unrealistic responsibility on preparers to look into the future. However, others, such as The Ohio Society of CPAs (2008) and the Washington Society of Certified Public Accountants, suggest that lengthening the bright-line time horizon is likely to lead to little abuse, and perhaps a time line of at least five years from the end of the reporting period may be appropriate for quality reporting and auditing.

Potential Conflicts between the Parties

Grant Thornton (2008) believes there is consistency between the proposed standard with IAS 1, *Presentation of Financial Statements*, in limiting the consideration beyond one year to a reasonable period of time, but that qualification does exist in the authoritative auditing literature in the United States. The Exposure Draft’s “all available information about the future” fails to limit the future to a reasonable period of time, which then requires an entity to consider information indefinitely into the future.

Deloitte (2008) further points out that the auditing literature is very specific for good reasons, originating with SAS No. 34, *The Auditor's Consideration When a Question Arises About an Entity's Continued Existence*, where the 12 month time period was discussed and subsequently brought forth into SAS No. 59. Deloitte further points to AICPA Statement of Position 94-6, *Disclosure of Certain Significant Risks and Uncertainties*, where the time period does not exceed one year. Additional arguments could be made that financial statements would likely depart from the reliability criterion of Concepts Statement No. 2, *Qualitative Characteristics of Accounting Information*.

To avoid conflict with disclosure requirements found in the auditing literature, management's plans should not only include discussion on how to mitigate the effect of uncertainties, but also the conditions that prompted the concern in the first place. Accordingly, resolution is then disclosed for alleviation, or successful turnaround, at least in thinking or assessing, if not in actuality. PriceWaterhouseCoopers (2008) suggests inclusion in the proposed Statement that "Substantial doubt about the entity's ability to continue as a going concern may have existed, but was alleviated prior to the issuance of the financial statements."

On the preparer side, the Institute of Management Accountants (2008) voiced practical concerns that the Exposure Draft as currently structured would impose limitations on the ability to predict how long an entity will continue in existence, and suggest that the one year window be retained and the new standard only require an evaluation of whether there is "substantial doubt about whether the entity will continue as a going concern for a reasonable period of time, not to exceed one year from the date of financial statements."

Ernst & Young (2008) point to an auditor's report that is modified to express substantial doubt about an entity's ability to continue as a going concern can become a self-fulfilling prophecy, and that the auditor's conclusion with respect to an entity's ability to continue as a going concern "is one of the most important judgments made during the course of the audit."

The Accounting Standards Executive committee (AcSEC) and Auditing Standards Board (ASB) of the AICPA drafted a joint letter of comment (2008) to the FASB, arguing that the lack of a definition of "going concern" would place a harsh burden on both preparers and the auditors as each must struggle with an unknown target. They made the point further that some language in the FASB's explanation, which is not part of the formal draft of the proposed standard would improve the usability, arguing that "management should consider events or conditions occurring 'just beyond' the one-year time horizon that are significant and most likely would need disclosure." This may be the compromise we ultimately see.

Legal, Social, and Macroeconomic Considerations

The proposed standard does not provide descriptions of application guidance. If the time horizon of IAS 1 is utilized rather than the time horizon of AU 341, management as well as the auditors, will need to have examples of the application.

What the financial statement users really need is disclosure of the assumptions by management in assessing their own viability and continuity of being a going concern.

The expanded time horizon would most likely expose preparers and auditors to greatly increased and unwarranted liability. With a hostile legal environment, the longer, open-ended timeframe will permit the surfacing of charges by plaintiffs and regulators.

Asking management to "take into account all available information about the future, which is at least, but is not limited to, 12 months from the end of the reporting period," may likely be far too bold. In the

current financial and economic environment, few external appraisers are able to predict with clarity. Accordingly, is it unreasonable to expect management to make valid and reliable judgments about events and conditions that exist in the future, especially beyond one year?

CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Macroeconomic conditions and entity-specific financial information are not the same thing, nor should they be expected to be. Taken to the extreme, the Exposure Draft would require that such knowledge (about the general economy) be presumed, assessed, and audited. Perhaps selective disclosure is warranted—stopgap safety measures are not required to be disclosed—how to fix the spill caused in an offshore drilling rig, dealing with a Tsunami flood, and other natural catastrophes. The existence or non-existence of backup systems may likely be of more concern to the financial statement users than the affixing of blame and hypothetical assessments.

The Exposure Draft was issued on October 9, 2008 with a brief comment period to December 8, 2008. While 29 letters of comment from individuals and accounting groups were submitted critiquing the Exposure Draft's nine brief paragraphs, the proposed statement is still a proposed statement. Once issued, it will be fruitful research to investigate which areas of the Exposure Draft were changed and why. It will be even more interesting working over the future years with a standard that was proposed quickly, then studied long and hard, and then hopefully, becomes part of the better exposition of financial accounting and reporting literature.

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INCORPORATING SUSTAINABILITY INTO THE TAX CODE

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ABSTRACT

The concept of sustainability has been moved to the center of our collective conscientiousness in recent years with the realization that it is imperative that everyone must act in an environmentally sustainable manner if this planet is to survive. The origins of sustainability, or eco-taxation, are reviewed. This is followed with a discussion of the issues involved in incorporating sustainability into the tax code. Some existing sustainability tax measures are reviewed and evaluated in light of their effectiveness. Finally, a framework of necessary components for successfully building sustainability into the tax code is presented.

INTRODUCTION

When Adam Smith postulated his principles of good tax policy he probably had no conception of the extent to which taxes would be utilized as instruments of economic and social policy. He was of the opinion that the tax system should not attempt “social engineering.” According to Smith, a tax system should not attempt to encourage or discourage certain types of behavior. [10] Today, most lists of good tax policy go far beyond Smith’s principles of equity, certainty, convenience, and efficiency.

The tax code as an instrument of economic and social policy is now taken as a given. Often, these social and economic policies form the overriding factors in tax policy, while the raising of revenues is seen as secondary. In the arena of environmental taxation, credits or deductions for energy-efficient expenditures are commonplace. Congestion fees are levied to discourage use of highways during periods of heavy use. [19] Taxes on natural resources have been levied to help reduce consumption. Carbon and sulfur emissions have been the subject of tax levies. [6] These taxes are not designed to raise governmental revenues, but to discourage undesirable behaviors. Indeed, the ideal is to not collect any of these taxes as the behavior is eliminated.

This area of taxation is known by a number of names – green taxation, eco-taxation, energy incentives, or environmental taxation. Each of these, while focused on similar objectives, seems to lack a macro-view of the subject. Green is a popular word today, but the term in relation to the environment seems to be a fad. Eco-taxation suffers from a lack of identity. Does “eco” stand for economic, ecology, or some other term? The term environmental taxation has been defined as a tax aiming to ensure that polluters face the true cost of their activities by charging them for the damage done to others. [21] This approach is more of a “stick” approach and offers no “carrot” to encourage environmental stewardship. Energy measures do not cover the entire area of taxation, but tend to focus on the incentive side. One term has not received a great deal of usage, but seems to be superior to the others. Sustainability taxation. This term includes environmental taxation but takes a larger view, a view toward doing what is necessary to assure a sustainable future for this world. This term can encompass taxes, fees, or other measures that encourage businesses and consumers to move from less-desirable environmental actions to those that can help create a more sustainable future. Olivia Sprinkel defines sustainability as “a balance between the financial, human, and environmental.” [20]

The term “taxes” in the sustainable arena is not restricted to the classic definition of a tax, but encompasses any charge or fine levied by a governing authority that seeks to promote a sustainable lifestyle in society. Taxes, fines, charges, and tariffs all come under the sustainability tax umbrella.

ORIGINS OF SUSTANABILITY TAXATION

The concept of sustainability taxation was probably developed in 1920 by the economist A. C. Pigou. Pigou drew a distinction between the private and the social value of economic activities. A modern illustration of this principle would be the construction of a high-speed rail line. The users enjoy the private benefits – better access, quicker trips, convenience, and the like. The benefits are reflected in the price users pay to use the facility. But at the same time, there are social costs. People are displaced as the new train cuts through neighborhoods. There is an increase in noise. Localized pollution may increase. These social costs, or externalities, don’t enter into the calculations of the cost of the high-speed rail but must be included in determining the ultimate worth as an economic activity. To correct these problems, Pigou advocated government intervention. Where the social value of an activity was less than its private value the authorities should introduce “extraordinary restraints” in the form of user taxes. Pigou also realized that some activities have a social value exceeding the private value. Recreational parks, street lamps and other “public goods” are difficult projects to charge for, so the free market would not ensure an adequate supply. Pigou suggested “extraordinary encouragements” in the form of government subsidies to help assure an adequate supply of these “public goods.” [4] Pigou’s theories form the foundation of today’s concept of sustainability taxation.

USING TAXATION IN THE ENVIRONMENTAL POLICY MIX

There is no question that a successful approach to achieving a sustainable future will involve a mix of policy initiatives. Recycling, use of renewable energy sources, new technologies, and other measures will move this planet toward a sustainable future. But there must be in place an incentive to impel consumers and businesses to implement such sustainable actions. In a free-market economy, the pricing mechanism is found lacking in at least three respects:

- The overall price elasticity of demand for energy is low and the level of taxation on energy to induce substantial behavioral change will be too high to be acceptable.
- The regressive nature of environmental taxes will have negative effects on wealth distribution, as low-income groups are affected in a disproportionate way.
- There may be various obstacles or “market failures” which prevent efficient levels of energy-efficient investments. [3]

Relating to the first point, Fujiwara, et. al. observe that elasticity of demand for environmental taxes is important. If elasticity of demand is high, rapid and successful implementation of such taxes is possible. Such an example would be the implementation of a tax on plastic bags. Consumers use these because they are convenient and have no visible cost for their use. Hence, there is no financial benefit from not using them, and a switch to reusable bags (a viable substitute) carries a cost to the consumer. However, a tax on the plastic bags creates a cost with an incentive to invest in reusable bags. [7]

On the other hand, this is not the case for carbon taxes. Here, elasticity of demand in the short term is low and energy is an important input for large sections of the economy. Additionally, there are no reliable, low-cost alternatives to fossil fuels. Energy users are responsive to changes in the price of energy [5] This short-term elasticity and the lack of alternatives create problems for carbon taxes. However, Fujiwara et. al. observe that this does not eliminate the need for carbon taxes, but means that

the taxation scheme needs particular care to be effective without causing adverse effects. The methods, implementation, and structure need special attention. [7]

Sustainability taxes tend to be regressive, falling in a disproportionate measure on those in the lower income brackets. Behavioral changes are the ultimate goal of such taxes, but these changes take place over the long-term. Short-term implications should not be ignored as these will precede any behavioral changes. In enacting any sustainability taxes, analysis of the impact of the taxes must pinpoint which sectors of society are hit the hardest and those sectors that will not be able to adapt to the change. [5]

One approach is to utilize subsidies for those adversely affected by utilizing tax exemptions or refundable credits to compensate for the additional burden imposed by the tax. The Organisation for Economic Co-operation and Development (OECD) recommends against such an approach, as it may reduce the incentive to behavioral change. They suggest the exploration of other means to reduce the impact. These alternative measures can soften the effect of the tax while maintaining the price signal of the tax. Maintenance of the price signal keeps intact the incentives to modify behavior in an environmentally beneficial manner. [14]

The efficiency of these taxes remains an area of uncertainty. Energy taxes, by and large, are input taxes and should fall on production as well as consumption. In order to avoid distortion in production, the tax, however, should be limited to final consumption. This is a less-expensive approach to collecting the tax. [13] However, this approach does not provide any incentive for the producer to avoid negative environmental externalities. Inclusion of exemptions, revenue recycling, or other approaches in an attempt to minimize the regressive effect can raise the administrative costs and render the tax an economically inefficient one.

DOUBLE DIVIDENDS?

Proponents have often argued that sustainable taxes are “fiscally neutral,” meaning that new environmental taxes would be offset by decreases in existing taxes often related to payroll. Citing the best of both worlds, a “double-dividend” was declared for environmental taxes. The first dividend relates to environmental improvements and the second dividend comes as payroll taxes are reduced. [7] Unfortunately, the “double dividend” effect has not been empirically proven and there is evidence that it does not hold up to detailed analysis. While there has been a modest tax shift, it is not seen as a validating the double dividend theory. [12] One possible reason for this failure may be that the fiscal neutrality approach has given lobbyists an opportunity to seek generous exemptions in order to achieve this fiscal neutrality. These lobbying efforts frequently create adverse effects on environmental effectiveness. [7]

A related topic is “revenue recycling.” Under this concept, funds obtained through taxes or levies on environmental pollution are “recycled” as credits for specific purposes that generate environmental benefits. For example, a credit for the installation of energy-saving investments could be paid from funds obtained from taxes on environmental pollution. This approach depends on the lack of government failure. The government must allocate and recycle these revenues efficiently and avoid distortions and transaction costs. [7] Earmarking, along with government bureaucracy can be sources of efficiency losses.

In the United Kingdom, revenues from sustainability taxes have been used to reduce the rate of employers’ National Insurance Contributions. Additionally, grants are made to support research and development projects, interest-free loans, and funding for carbon emissions reductions. [7] One is

compelled to ask if this is the most efficient use of the funds as it invokes government bureaucracy in decisions regarding the allocation of the revenues.

SUSTAINABLE TAX MEASURES TODAY

Nations have approached the implementation of sustainable tax measures with a variety of methods. As discussed earlier, Pigovian taxes are seen by many as the ideal approach to per-unit taxes on emissions or discharges. Unfortunately, this approach has seen limited use. Outside of Europe, no nation has adopted the Pigovian model. However, the thirty-two signatories to the OECD have utilized indirect environmental levies that include taxes on fuels, vehicles, beverage containers, fertilizers, and other environmentally harmful products or activities. These levies are growing in importance in OECD nations. [2]

CO₂ taxes are growing in importance as most West-European nations have implemented some form of this tax. The effectiveness of these taxes has been limited due to differing systems in each country. Ivan Hodac, Secretary General of the European Automobile Manufacturers' Association (ACEA) stated that CO₂ taxes are important in shaping consumer demand toward fuel-efficient vehicles. He called for similar taxation measures in all countries in order "to give a clear market signal which will be decisive in achieving the desired cuts in CO₂ emissions." He further stated that fragmented systems have a distorting effect on the internal market. [1]

The Spanish corporate income tax includes a tax credit for environmental investments. Originally introduced in 1996, it has been expanded a number of times. The current focus awards a ten percent credit for certain environmentally-friendly investments that go beyond the legally required minimum. In addition, there is a 12 percent credit for purchases of new land-based means of transportation for commercial or industrial use. A second ten percent credit is available for investments in new tangible assets for the use of renewable energy sources. [22]

The Spanish approach appears to be well-intended but have a number of enforcement issues that have diluted the environmental benefits of the credits.

The United Kingdom has taken a leadership role in approaching the problem of climate change, adopting a strategic, long-range focus. Prior to 2009, the UK had made significant strides toward reducing carbon emissions. Existing policies are enabling £50 billion in low-carbon investments through 2011. Additionally, these policies have supported 900,000 jobs. Budget 2009 provided over £1.4 billion of additional targeted support in the low-carbon sector. Other measures promise an additional £10.4 billion of low-carbon sector and energy investments over the next three years. This promises to place the UK at the forefront of worldwide low-carbon recovery. Budget 2009 sets forth the world's first carbon budgets as required in the recently enacted "Climate Change Act." This includes a legally binding reduction of 34 per cent reduction in emissions by 2020. [8]

Other provisions in Budget 2009 include funding for energy efficient measures to help various segments of society to use less energy, including a reduction in the value-added tax for energy-savings materials. There a goal of increasing renewable energy tenfold. A notable inclusion in this area is the establishment of community heating systems. These systems generate heat at a centralized location and transmit heat via pipes. Low-carbon technologies are also a part of the budget. None of these initiatives are tied to a specific tax resource, but reflect the importance the British place upon achieving a low-carbon future. £365 billion in other energy-efficient schemes are planned with the intent of reducing emissions, saving money, and helping employment. [8]

The United States has lagged behind its European counterparts in attempting to create a sustainable environment, particularly in regard to utilizing the tax structure to help implement effective sustainable policies. Four federal laws enacted since early 2008 contain provisions targeting energy conservation: The Economic Stimulus Act of 2008, the Housing Assistance Act of 2008, The Emergency Economic Stimulus Act of 2008, and the American Recovery and Reinvestment Act of 2009. [23] None of these statutes can be classified as sustainability or “green” legislation. They are enactments that contain certain elements of energy-efficient legislation. The environmental focus in each of these is on credits for energy-efficient buildings or building improvements. While this is a laudable move toward sustainability, it can hardly be expected to create a sustainable future for the United States.

This recent flurry of tax legislation is merely a continuation of Federal environmental tax policies that have focused on tax credits and deductions having positive environmental effects rather than sending negative price signals for environmentally damaging activities. The Energy Policy Act of 2005, like other legislation in the U. S., relied heavily on tax incentives for energy conservation investments. Included were incentives for energy efficient heating, cooling and lighting systems in commercial buildings; income tax credits for alternative-fuel vehicles; incentives for alternatives to coal-burning plants; and credits for wind farms producing electricity produced from wind power. [11]

The concept of congestion taxes has been utilized in a number of nations in a variety of circumstances. These have been applied to waterways, airports, and city-center hubs in addition to highways. Congestion taxes have been attempted at the state and local level in the United States on a limited basis. Transportation Alternatives has called congestion pricing the most powerful policy tool at the hands of [New York] City officials to reduce unnecessary driving, promote environmentally sound transportation, and finance twenty-first century improvements to the transportation infrastructure. If the revenues are utilized for this purpose, environmental benefits could become a reality. However, Owen takes a different view. He maintains that congestion itself can promote sustainability, as frustrated drivers become pedestrians or subway riders. [17] Congestion pricing has its advantages, but one of them does not seem to be a contribution toward a sustainable future any more than an income tax used for environmental purposes can be said to be a sustainability tax.

The plastic bag has become ubiquitous in our society as consumers use an estimated 500 billion of these bags annually. They are not biodegradable, they kill an estimated 100,000 marine animals annually, and they consume fossil fuels in their manufacture. And there are viable alternatives. With this in mind a number of nations have implemented a tax on each bag. Several cities and states in the United States are considering such proposals. The tax can run from five to thirty-three cents a bag, creating a strong disincentive for their use. If the consumer opts for an alternative, such as a reusable cloth bag, the retailer will purchase fewer bags with the end result that fewer plastic bags will be produced. Paper bags are also not environmentally friendly. Although they do degrade, they require the release of more greenhouse gases in their manufacture and transportation than plastic bags. [18]

The approach to taxing, rather than banning plastic and paper bags seems to be a valid approach. While proponents may desire that every nation ban these, the lack of universal acceptance does not diminish the local effect. While the “bag tax” seems to effectively reduce the consumption of plastic and paper bags, governments must be judicious how it approaches the use of these tax revenues. Since the goal is to eliminate their use, this is a revenue stream that can be expected to decrease rather quickly over time. When Ireland introduced its thirty-three cent tax per bag, consumption decreased 94 per cent in a matter of weeks. [9] This tax, then, is not one designed to bring in revenues, but to change behavior. As such, many see it as an ideal example of a sustainable tax.

A MODEL FOR SUSTAINABILITY TAXATION

We live in a global society where national borders are easily and frequently transcended. Any tax that seeks to promote sustainability in one nation will only be as effective as taxes enacted in other nations. Companies faced with some aspect of environmental tax regulation will be forced to do a cost-benefit analysis. “Is it more advantageous for the company to remain in its present location and pay the tax, or can the company benefit from moving its operations to another nation where there is a lower level of environmental regulation?” Obviously, one partial solution to promote sustainability would be for the “taxing” nation to include tariffs on imports of products manufactured in nations lacking the level of environmental regulation of the “taxing” country. This approach, however, is likely to result in a sustainable tax policy that is a patchwork of assorted laws and regulations, needing adjustment whenever one nation amends its sustainable tax policy. It would likely result in an ineffective global sustainable tax policy with resultant gaps and distortions.

Building on the Kyoto Protocol

What is needed for an effective sustainable tax policy is a global approach not unlike the existing Kyoto Protocol. A treaty similar to the Kyoto Protocol could be implemented to coordinate a global approach to sustainable tax policy. The future of the current Kyoto Protocol is in jeopardy. Without the participation of the United States and China, two of the largest producers of greenhouse gases, it is expected to expire in 2012. However, this can be an opportunity to craft a new, comprehensive approach to sustainability, incorporating the taxation tool.

Whether a part of a new Kyoto Protocol or some other approach, any such agreement must have certain characteristics to effectively promote sustainability worldwide. No matter what provisions are included in the treaty, or how effectively they promote sustainability, the effectiveness of the treaty will suffer without full-scale participation by all major nations. There are seven characteristics that must be addressed in a global tax sustainability effort – comprehensiveness, coordination, a Pigovian approach, removal of subsidies, social equity, visibility, and neutrality.

Neutrality

Neutrality will be addressed first, as it is a characteristic that should not be present in seeking to achieve a sustainable tax policy. Tax neutrality is generally defined as a tax that does not cause entities to shift economic choice among alternatives. Policymakers frequently depart from this concept in order to achieve specific goals. In promulgating taxes to encourage sustainability, the objective is to alter behavior to achieve sustainability. Therefore, sustainable tax policy should not be neutral.

A second aspect of neutrality is the concept of revenue neutrality. Many who advocate a sustainable tax policy seek a revenue-neutral policy. Part of this is the widely publicized double dividend. Although some tax-shifting appears to occur the double dividend does not hold up to a close analysis. Morgenstern states that while environmental taxes do not provide a free lunch, they are a relatively economical approach to addressing sustainability. Environmental benefits associated with a tax shift are generally not costless. One must also remember that as behaviors are modified, revenues will decrease, offsetting any achieved neutrality. [10]

Comprehensiveness

While the need for a comprehensive sustainable tax policy has been addressed in relation to the need to have all major industrialized nations as participants, there is a second aspect to

comprehensiveness. This is probably the most difficult of the characteristics to obtain. A comprehensive sustainable tax policy approach must address all major aspects of sustainability. Failure to do so will result in gaps that nations, companies, and individuals may exploit. There are at least five considerations in forming a comprehensive sustainable tax policy.

First, the policy should contain a commitment to raising awareness of sustainability issues. If the public is aware of the purpose for these policies, there is more likely to be a buy-in. Second, the policy should promote efficient use of and conservation of energy, water, and other resources. Elements of this portion of the policy could include incentives for the use of conservation measures, construction of energy-efficient buildings and machinery, and the use of renewable energy resources. Likewise, the policy could contain penalties for non-sustainable use of such natural resources.

Third, the policy should encourage the minimization of solid waste production. This could include incentives to implement the three “R’s” – reduce, reuse, and recycle. Closely related is the fourth consideration, that of minimizing hazardous waste and toxic materials. Finally, the policy should provide tax incentives to encourage incorporation of sustainable design and planning principles in development, construction, and operation of infrastructure, grounds, and building. In addition to the more obvious tenet of designing sustainability into buildings, sustainable landscaping practices could be included. Additionally, planning could include a commitment to pedestrian travel, bicycle use and other modes of transportation that promote a sustainable environment. This can include tax incentives for the purchase and use of bicycles, implementing environmentally-friendly transit, and making the use of these modes of transportation convenient to the public.

Coordination

As has been observed, we live in a global society. From a sustainable tax view, the characteristic of coordination has two implications. Companies who are not environmentally responsible may seek to relocate to an area with fewer environmental restrictions. Additionally, those areas with fewer environmental restrictions do not exist in isolation. Non-sustainable activities carried on in these areas will have a spillover effect, creating environmental and other difficulties that extend beyond their borders. A global sustainable tax agreement, coupled with other global sustainable agreements is the most effective manner to isolate and eliminate non-cooperating nations. When all major industrialized nations have ratified the agreement, the opportunity to shop for a “better” venue will be eliminated or greatly reduced. Tariffs can be levied on exported goods produced through non-sustainable processes in non-participating nations.

The Pigovian Approach

Pigovian taxes are designed to correct negative externalities that arise in the marketplace. There is no question that negative sustainable actions occur in an open economy. Often, these externalities arise not from malice, but from ignorance or lack of the availability of a sustainable alternative. The issue of plastic bags is a prime example. Consumers have used these bags by the billions, primarily due to the lack of any alternatives. As other alternatives became available, and the consumer was made aware of the problems created by plastic bags, their use declined. However, their use did not drop to levels most would consider acceptable. Therefore, a Pigovian solution was called for. When governments levied taxes on the use of plastic bags, their use declined significantly. Businesses were caught between the issue of paying the bag tax themselves, or passing it on to the consumer. Neither was seen as a workable solution, so alternatives to plastic bags were made available.

Removal of Subsidies

In somewhat of a “reverse Pigovian” approach there are many tax subsidies in place that damage the environment and hamper sustainability efforts. These subsidies should be eliminated. Among the culprits in this area are tax preferences for oil, mining, and timber. In the United States, a sport utility vehicle is eligible for tax breaks not available for passenger vehicles weighing less than 6,000 pounds. The mortgage interest deduction is even at fault, as it subsidizes home ownership and makes second and larger homes more affordable. Removal of such subsidies and adoption of the Pigovian approach would have the effect of requiring polluters to pay taxes on their activities that are not environmentally friendly.

Social Equity

Social equity is another difficult issue in relation to sustainability. Any public policy will affect some members of society more than others. Steps must be taken to assure that the burden of sustainable taxation does not fall unjustly on low-income households. Implementing sustainable taxes and paying a lump-sum subsidy to certain qualified households is one suggestion. Another approach would apply different rate structures based on household income or exempt some groups from the tax measure. [15] A second aspect of social equity is dealing with nations that are poverty-stricken. Aid from industrialized nations can assist these countries in improving their economy through the use of sustainable measures.

Visibility

A tax that is not understood is not visible. As a result, it will not achieve a high level of support. In order to make sustainable taxes visible they should be distinct, non-discriminatory, and defensibly quantified. A tax is distinct when the basis for setting the tax is clear and it is distinguished from other taxes. A non-discriminatory tax should be applied to all similar sources of environmental and social damage. For example, coal, heating oil, and gas should all bear their share of the environmental tax as each is a source of carbon dioxide and other pollutants. A tax is defensibly quantified if the proceeds from the tax are utilized to combat environmentally harmful activities rather than being viewed as a revenue measure. [13]

TAXES AS ONE COMPONENT OF SUSTAINABLE POLICY

Taxes are not the only policy instrument in the hands of government in order to bring about a sustainable future. Indeed, they are only a part of the macro view of sustainability. Therefore, sustainable tax policy must be a part of an effective and economically instrument mix. To achieve this, three requirements must be met.

First, there must be a good understanding of the environmental issue being addressed. Over 2,500 years ago, Chinese General Sun Tzu stated “Know thyself, know thy enemy.” Effective action comes when participants understand the environmental issues involved and why they are issues. Secondly, there must be a good understanding of how tax policy links with other policy areas. An effective policy will not be achieved if each policy area does not interact and coordinate with the others. Finally, there must be a good understanding of the interactions between the different instruments in the mix. These instruments must not counter balance each other. [16]

CONCLUSION

Taxes can be an effective tool in the policy mix to achieve sustainability on our planet. However, to be effective, the policy must be global in nature. A well-designed policy instrument similar in nature to the Kyoto Protocol will be the best hope for achieving this objective.

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OUTSOURCING COSTS – AN ACCOUNTING CHALLENGE

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ABSTRACT

What are the costs of offshore outsourcing? While much has been written about the “hidden” costs of offshore outsourcing, the specifics are not well defined or documented, but are probably higher than most companies expect. Unfortunately, many, if not most, companies do not really know what their outsourcing costs are because of the difficulty in identifying and measuring them. This paper highlights some of the difficulties and offers some approaches to determining offshore outsourcing total cost of ownership (TCO).

Outsourcing Costs – An Accounting Challenge

Outsourcing! Is it a trail of broken promises or the new path of modern management? It depends on your point of view. One observer believes that “Most people have made up their minds about these topics and aren’t open to different points of view. Some people think outsourcing is a wonder of a free-market economy; others see in it nothing more than an immoral disregard for loyal employees.” (Gibson 2005) For a business, it may depend on whether it is just trying to save the next quarter’s results or design and nurture relationships that will help the company survive and prosper in the future. The APICS Dictionary defines outsourcing as “The process of having suppliers provide goods and services that were previously provided internally. Outsourcing involves substitution—the replacement of internal capacity and production by that of the supplier.” (Blackstone 2008). This version extends outsourcing to both goods and services. Although not stated in the above definition, outsourcing can be to either domestic or foreign suppliers. Outsourcing is also called business process outsourcing (BPO).

We will view outsourcing from the U. S. perspective; however, it is a global issue. It is both a tactical and a strategic decision area; consequently, it has major implications for a business. However, some companies appear to be making this decision based more on the prospect of short-term gains without carefully considering the long-term implications. In this paper, we will attempt to outline a systematic approach to the outsourcing decision-making process, a process that will depend heavily on the accounting function’s participation and guidance.

In the first section of this paper, we pose several questions that must be addressed in formulating an approach to outsourcing. The main thrust of the paper will be in outlining the difficulty in determining the total cost of ownership (TCO) and offering a possible approach that could be used.

Present Situation

Outsourcing is not new. On the manufacturing side, the “make or buy” decision has long been a basic consideration. On the services side, all types of companies have outsourced such business support functions as food and custodial services. As information technology facilitated global communications, it became possible to outsource call centers and help desks, hire well-trained persons to write programs, have medical technicians read X-rays, accountants to prepare your taxes, and even business journalists interpret companies’ financial statements (Thottam 2004)

However, there are growing pains in outsourcing. The Aberdeen Group (Enslow 2005), in a survey of 170 companies, found that “The biggest challenge for companies going global is how to keep the supply chain moving without exploding the sourcing savings or sales opportunity that enticed them to go global in the first place. This requires synchronizing logistics, compliance, and finance processes.” Over 90% of the companies felt pressure to improve their global trade process because: (1) lead times are inhibiting their ability to respond to market demands, and (2) expected product cost savings are being eroded by unanticipated global supply chain costs. Deloitte also found that a number of companies experienced unsatisfactory results in their outsourcing projects (Landis et al. 2005). The pressure is not to forsake outsourcing but to establish an integrated system of outsourcing that more carefully selects and manages the outsourced projects, especially after considering the total costs and benefits.

Should a company consider outsourcing?

As the business environment becomes more complex, it is increasingly difficult for a company to be sufficiently competent in all facets of a business. Therefore, they must seek help from more qualified sources. Yuva (2005) offers the following reasons for going global: (1) To gain a global perspective; (2) The cost/value benefits; (3) Greater access to product and process technology; and (4) To facilitate the transition from selling to buying in a region.

There is a caveat, however. It is a complex decision that requires both a good decision-making process that is systematic and comprehensive to supplement good judgment. Outsourcing is far from a “no-brainer” decision. The decision to outsource should follow a comprehensive analysis, rather than reacting to short-term considerations (Yuva 2005; Gottfredson 2005; King 2000).

Why should we outsource?

What are the drivers of outsourcing? While anticipated lower cost may be the primary driver, there are others, such as added capacity, technical knowledge, and perceived simplification of the remaining slimmer organization. The last may not be a realistic expectation. “What outsourcing does is trade the hassles of managing information technology and networking operations for the hassle of managing alliances.” (Gantz 1990).

What are some of the factors to consider in the analysis to outsource? King (2000) proposes a model that includes: (1) Short-range Operational Impacts, such as efficiencies, cost savings, productivity and service levels; (2) Mid Term Tactical Impacts, such as performance, control and risk sharing; and (3) Long-range Strategic Impacts, such as developing core competencies and learning competencies. This model emphasizes that the decision to outsource has long-term implications Davidson (1990) cautions that the best form of organizational structure for outsourcing may not evolve for years. A list of more (but not exhaustive) detailed decision criteria could include: Short-term costs vs. long-term value, lack of skills in U.S., quality of product or service, delivery time, customer attitudes, social acceptance, loss of in-house capability, need for project management skills, effect on political image, and effect on national security. Whatever the criteria, the decision is a complex one.

Companies increasingly view outsourcing as a strategic decision, not a tactical decision. As a result, they consider the impact of the decision over a longer time horizon and include a greater number of factors in making the decision.

What should we outsource?

Companies continue to reduce the scope of support functions performed internally. First, companies outsourced food and custodial services. Next came human resource functions such as payroll, employee testing and screening. Today the focus is on information technology. Many companies no longer consider these support functions as core competencies.

At what point does the concept of “preserve the core competencies” fall apart? While the consensus among researchers is that preserving the core competencies of the firm is important, they do not agree on how to determine the core. Some even suggest that R&D is not beyond the reach of the outsourcers (Engardio and Einhorn 2005).

At any rate, companies will become more selective in “what” they outsource. The question will not be just whether to outsource; it will be what and to whom.

When do we outsource?

As part of the longer-range perspective, more companies will consider what their costs could be if they implemented continuous improvement programs, such as JIT, lean production, Six Sigma, and supply chain management. With internal improvements, outsourcing may not be as attractive.

Some advocate taking careful stock of your processes before deciding to outsource. The classic paradox of outsourcing is that businesses are often told not to outsource their problems. However, if a process is running smoothly, then why outsource it? Many times, the better a process works internally, the more money you are likely to save by outsourcing it, because the transition will be simpler, allowing the

outsourcer to focus more on optimization. So how do you decide which processes are best suited for BPO? This depends on two factors: deciding which ones have the least strategic value to your company, and then evaluating which of those processes are in the best shape. (Moore 2005) Perplexing, isn't it?

Where do we outsource?

Outsourcing does not always mean global or offshore outsourcing. A company should always first consider making the product or performing the service. Next, to capitalize on the convenience of proximity, they should consider domestic suppliers. Finally, they should look to offshore suppliers. In making the decision, companies balance the tangible benefits of offshore outsourcing, such as lower costs and increased capabilities, with the increased risks and uncertainties of remote suppliers.

To whom should we outsource?

Should a company distribute their outsourced products or services among a number of suppliers to lessen the risk of losing intellectual property or concentrate its outsourcing in a few, or even one, company? Some major consulting companies are gearing up to provide integrated services. IBM announced a new emphasis that would enable them to offer complete management services in such diverse areas as finance, human resources and customer service (Hamm 2005). This decision boils down to a choice between spreading or concentrating risk.

How do we go about outsourcing?

After making all of the decisions outlined above, the next phase involves outsourcing the product or service. There are many companies eager and able to help in this phase of the work. Selecting one of them to help is a major project, and well beyond the scope of this column. The Outsourcing Institute is a good place to start. (www.outsourcing.com)

As businesses outsource services, the remaining organization becomes more streamlined. While streamlining may suggest that it is simpler, it is not. The relationships, both within the business and between internal and external entities, become more complex and require attention to assure satisfactory results. Davidson (1990) emphasizes that the human resource function is necessary to help in the outsourcing program by providing help in internal organization realignment and coordination of the strategic alliances formed by outsourcing. This requires greater coordination among the involved entities.

The role and scope of the purchasing function will change significantly. It will have greatly increased responsibilities for internal and external coordination of the various outsourced projects. As the amount of outsourcing increases, some businesses will probably create an "Outsourcing" function within the organization with greater cross-functional responsibilities, perhaps initially a part of purchasing but eventually a more senior level function responsible to top management.

The information technology function is necessary in the outsourcing program to provide help in setting up the electronic communication and interorganizational interfaces necessary for outsourcing. It also means that some elements of the information technology function should be retained, not outsourced.

How do we evaluate the total cost of ownership?

One of the most difficult questions to answer is the eventual total cost of ownership (TCO) of an outsourced good or service. In this section, we will summarize some of the ideas and models proposed to address this issue. We will also offer some ideas about what tools are available to use in estimating the TCO. As a reference for the items to be considered in the TCO analysis, we will use those shown in Figure 1, which were adapted from Cavinato (1992).

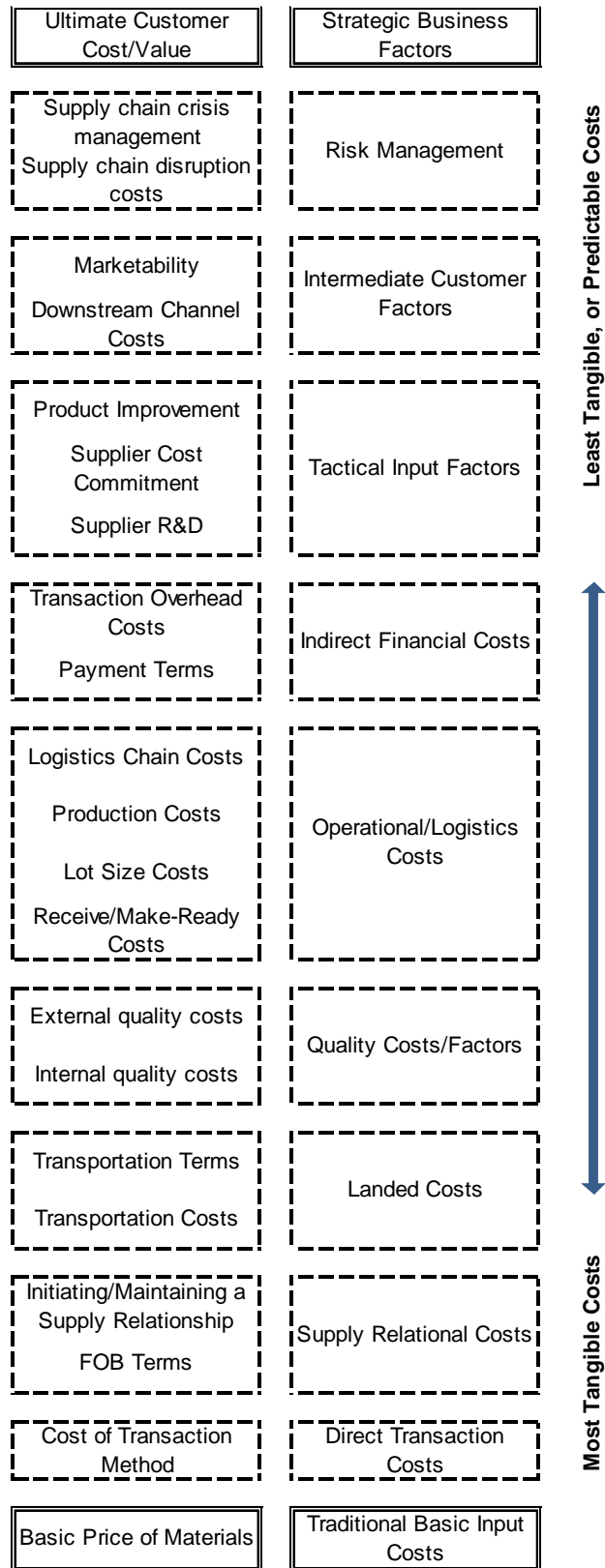


Figure 1. Total Cost of Ownership (adapted from Cavinato 1992)

The approaches to measuring and controlling purchasing and logistics functions such as outsourcing, have evolved over time. In general, the progression has been from an internal focus on item purchase cost to a much wider perspective that looks at total costs and revenues along the supply chain. One such progression is:

1. Lowest price
2. Lowest landed cost
3. Lowest total cost to the firm
4. Lowest total cost to the final firm in the entire supply chain
5. Highest total value to the ultimate customer of the final firm in the supply chain (Cavinato 1992)

Some recommend a regular (annual or at the end of a contract) review to reevaluate the effect of economic and political changes, as well as the vendor performance (Yuva 2005). Others suggest that the reviews should be often enough to prevent the loss of in-house critical resources and competencies (Gottfredson et al. 2005). Companies should view outsourcing as dynamic, not a “one and done” kind of decision. While we agree the outsourcing decision should be reviewed periodically, our discussion in this paper will be confined to the initial decision to outsource.

The offshore outsourcing decision has three components: the economic decision, the ethical decision and the political decision. While these areas have different issues, at some point all of the considerations must be wrapped up into the decision to outsource or not. We will deal primarily with the economic decision, although both the ethical and political issues have economic implications.

Economic decision

The economic decision requires the identification of potential changes in costs and revenues. Figure 1 is adapted from a model developed by Joseph Cavinato (1992). It covers a wide range of costs, from the most tangible at the bottom of the diagram, to the most intangible, at the top of the diagram. While the costs are real, they are difficult to determine. Many, if not most, companies have not developed a formal analysis method to systematically determine these costs. Later, in this paper, we will outline the beginnings of an approach that could be used to compute the total cost of an outsourcing event. It is still in the formative stages; we hope to have it more fully developed in the final paper.

Ethical decision

The ethical decision is even more difficult than the economic decision. In general, it involves several stakeholder groups – employees, managers, shareholders, consumers and the general public. The overriding question is: Will customers buy more if a company’s outsourcing results in lower prices, or will customers buy less because they are more negative toward the company because of its outsourcing practices?

Political Decision

The political implications are also beyond normal analysis methods. What will the federal government do with respect to outsourcing practices? Will they try to regulate the practice? If so, will they encourage outsourcing as a step toward expanding global markets, or will they restrict outsourcing because it causes disruptions in jobs, in the form of layoffs and the need for retraining and reeducation?

Approach to Decision Making

One approach to this decision process can include the following steps:

1. Compare the tangible, and recurring, costs of producing versus outsourcing. Tangible costs can include both the direct product costs and the indirect support costs. Table 1 illustrates such a comparison.

2. Using a weighted factor analysis table, compare the costs and benefits for intangible items, such as loss or gain of intellectual property, managerial time, and the effect on morale of remaining employees. Table 2 illustrates this approach.
3. Estimate the return on investment, using a time value of money approach, for the project of converting from making to outsourcing. Figure 2 illustrates this approach.
4. Develop an expected value decision tree for potential non-recurring costs that may arise from disruptions in the supply chain, such as from product recalls, earthquakes or the introduction of innovations from competitors. Figure 3 illustrates this approach.
5. Summarize the results from the first three steps in a weighted factor analysis table. This step must include the expected effect of ethical and political considerations. Table 3 illustrates this approach.

The examples in this paper are for illustrative purposes only. We will develop more comprehensive and integrated examples of this approach for the final paper.

Table 1. Comparison of Quantifiable Costs

Total Annual Costs (thousands of dollars)		
	In-House	Outsourcing
Product Costs		
Direct materials	50	
Direct labor	10	
Variable overhead	15	
Total direct costs	75	
Purchase costs		50
Inbound freight or delivery	5	7
Space	3	1
Depreciation	3	1
Fixed overhead	3	4
Total expenses		
Working capital costs		
Inventory	8	24
Total Cost	97	87
Net Savings		10

Table 1 shows a comparison of making in-house versus outsourcing. The hypothetical numbers indicate a large reduction in the product costs, as well as in space and depreciation costs. Freight costs increase because of longer distances, and fixed overhead increases because of the need for trips to set up new suppliers and maintain close relationships with them. Inventory costs increase significantly because of longer lead times and the need for increased safety stock in case of supply chain disruptions. The net effect is a savings for the outsourcing alternative; however, the analysis suggests the need to carefully consider added costs, some of which are not readily available in today's accounting reports.

Discounted Net Costs and Savings				
	Minimum acceptable rate of return			20.0%
	Erosion of savings per year			5.0%
	Base amount of savings per year			\$15,000
Year	Type of Cost	Discounted Net	Raw Net	Eroded Value
0	Drop current system	(50,000)	-50000	
1	Net savings	12,500	15000	100%
2		11,875	14250	95%
3		11,250	13500	90%
4		10,625	12750	85%
5		10,000	12000	80%
6		9,375	11250	75%
7		8,750	10500	70%
8		8,125	9750	65%
9		7,500	9000	60%
10		6,875	8250	55%
	Reinstate in-house	(41,667)	-50000	
Present Value Net Inflow (Outflow)		\$5,208		

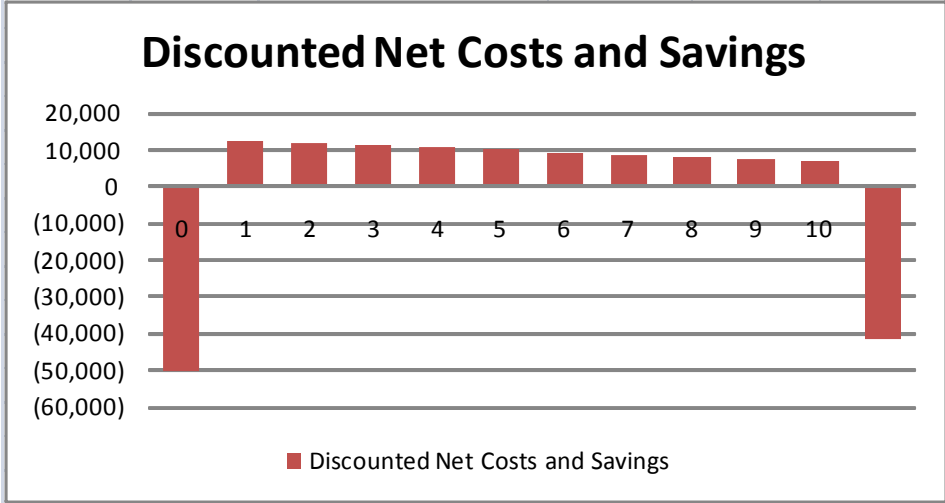


Figure 2. Net Present Value of Making Transition from In-House to Outsourcing

Table 1 is composed of ongoing costs. Figure 2 considers the one-time cost of making the transition from making a product in-house to outsourcing it. A discounted cash flow method is used to show the initial costs of dropping the present system, recovering these costs over a ten-year period, and then making the transition back to in-house, or shutting down the total operation.

There are three basic assumptions. First, the minimum acceptable return on investment, or hurdle rate, is known; in this example, it is 20%, but it could be varied as desired. Second, the estimated annual savings has been determined - \$15,000 in the example – probably from an analysis such as shown in Table 1. Finally, there is an assumption that the annual savings will diminish over time, perhaps from increased labor rates in the company doing the outsourced work, from increased transportation costs, or some other source of increased costs. In the example, this is assumed to be a 5% reduction per year.

The costs of dropping the present system could include salvage costs of equipment no longer needed, severance or transfer costs of displaced employees, and public relations costs of informing appropriate stakeholders. The costs of starting the outsourcing option could include any new investments, training of vendors and their learning curve efforts, moving equipment, start-up inventories and management time and expense of sourcing, selecting and establishing suppliers (Cavinato 1988) The cost shown at the end of Year 10 is the cost of reversing the decision or otherwise terminating the project. However, there is a good probability that some disruptive force will cause the outsourcing decision to be re-evaluated before the end of the ten-year period.

Table 2. Comparison of Make vs. Outsourcing

Comparison of Make vs. Outsourcing					
Condition A:		Factor			Comments
	FACTOR	Weight	Make	Outsource	
1	Quality - ppm	0.30	9	8	Additional sampling
2	Delivery - on time, right quantity	0.20	9	7	Moderate disruption
3	Effective communication	0.20	10	7	Improve over time
4	Technical - product improvement	0.10	8	8	Supplier has knowledge
5	Cost improvement	0.10	5	10	Low initial cost
6	Collaborative relationship	0.10	10	7	Culture differences
7					
8					
9					
10					
Total Score		1.00	8.8	7.7	
Closeness Factor		90%	BEST		

One of the more difficult parts of the analysis is trying to determine the incremental costs or benefits in the less tangible areas, where numbers are not readily available. The weighted factor analysis approach offers a way to combine both tangible and intangible factors. Table 2 is an example of this approach. It requires analysts to develop a consensus in three areas – the choice of factors to be evaluated, the relative weight to assign to each factor, and a rating for each factor in each alternative. These are not easy choices and require the combined thinking of key members of the outsourcing team.

The factors in Table 2 contain two factors for which quantitative values could be developed outside the weighted factor analysis – quality and delivery. However, the performance measures used for these factors are often physical measures, not financial measures. Consequently, they must somehow be translated into a measure compatible with measures used for other factors.

Whatever measures are used, they would have to be rated on the ten-point scale used. The remaining factors would not likely have convenient measures, so they must be judged by the team doing the ratings. In this example, the pendulum swings to keeping the product in-house because of factors other than cost.

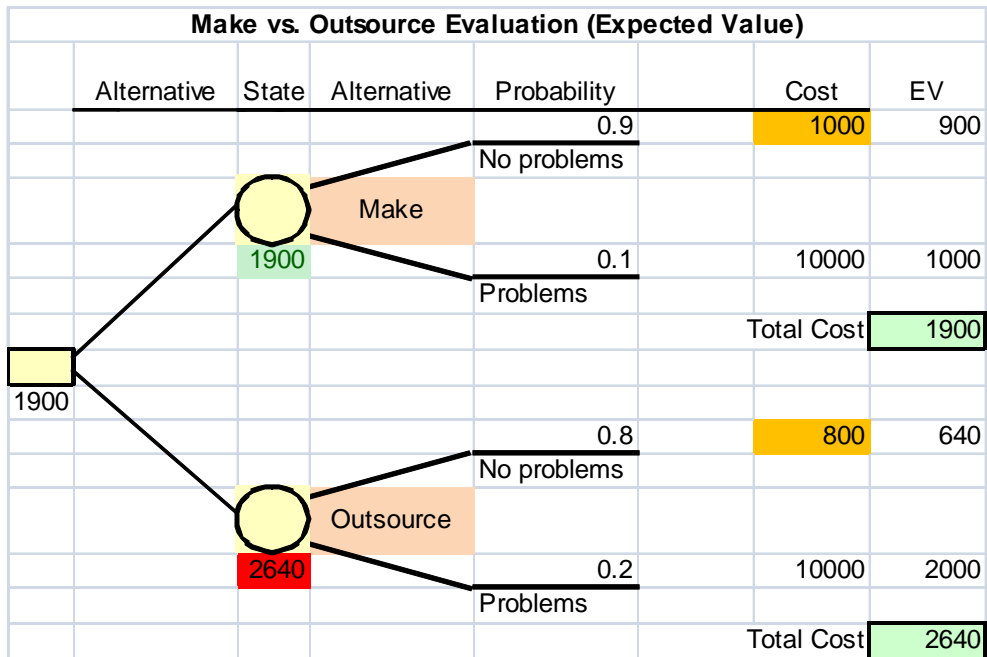


Figure 3. Expected Value for Make vs. Outsourcing

Some costs can result from unexpected disruptions in the supply chain. These disruptions can include risks ranging from normal everyday variations to an enterprise-threatening crisis (Crandall 2010). The probability of occurrence also varies. Some variations may occur nearly 100% of the time and can be absorbed as part of the normal, tangible costs shown in Table 1. On the other extreme, a crisis may occur infrequently but could be extremely costly, even disastrous.

To handle the later type of cost, an expected value analysis can be used, as shown in Figure 3. The analysis is overly simplistic but shows how the potential effect of problems increase with the outsourcing alternative. Problems could be from quality defects, such as peanut butter contamination or Toyota brake pedals; or exposure of sweatshop suppliers, such as apparel manufacturers. In this example, the choice would be to stay in-house because of the increased risk from outsourcing.

Table 3. Final Comparison of Make vs. Outsourcing

Comparison of Make vs. Outsourcing					
Condition A:		Factor			Comments
	FACTOR	Weight	Make	Outsource	
1	Tangible costs	0.50	7	10	Primary advantage
2	Intangible costs	0.20	9	7	Management and admin
3	Transition costs	0.20	8	6	High initial costs
4	Disruption costs	0.10	9	5	Distance and complexity
5					
6					
7					
8					
9					
10					
Total Score		1.00	7.8	8.1	
Closeness Factor		90%	GOOD	BEST	

To make some reasonable final comparison, a weighted factor analysis could be used, as shown in Table 3, where each previous analysis is assigned a rating (on a 10-point scale). As stated before, the numbers are hypothetical but are representative of the observed sentiments among writers. Outsourcing offers a major direct cost advantage but does not rate as well in other factors.

The challenge is for companies to find the time and numbers to insert into the approaches described above. The decision to outsource may be one of the most important ones a company can make.

The Future

The outsourcing trend will continue in the United States; however, many companies are being more cautious and some are recalling outsourced work because of unsatisfactory results (Landis et al. 2005).

Extensive outsourcing will require a major restructuring of the purchasing, or procurement, function. Purchased services will increase as a percentage of the total costs and their composition will increase in complexity. It will take a multi-functional team to effectively manage the outsourcing programs (Venkatesan 1992).

Project managers, and project management skills, will become increasingly important. While some in-house projects can be nursed along informally, outsourcing requires the formal coordination of functions and tasks, both internal and external.

While politicians lament the trend, it appears unlikely that the federal government will do anything substantial to stop the outsourcing movement (Gibson 2005). While there may be short-term hurdles, there will not be permanent barriers.

U. S. companies will continue to outsource, but at a more deliberate pace as they move up the learning curve. Companies will view outsourcing as a management function and will learn to analyze, plan, manage, evaluate and control the process. When appropriate, outsourcing will become a core function of a business.

Figure 4 displays a possible outcome of the outsourcing movement. We do not have data to support the curves; however, there does appear to be a slowing of the offshore outsourcing movement. The cost advantages begin to decline as wage rates and related costs increase in those favored supplier countries.

However, the benefits of increased revenues increase as outsourcing countries begin to make gains in the markets of countries to which they are outsourcing.

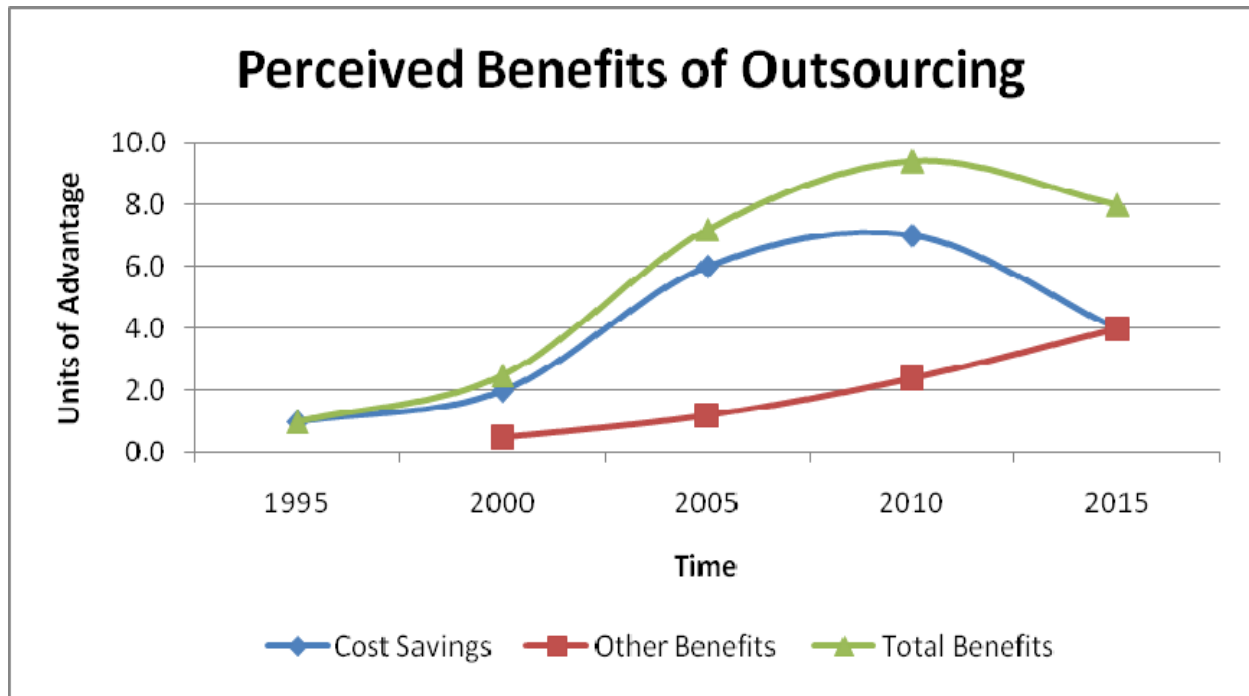


Figure 4. Perceived Net Benefits of Outsourcing Over Time

Who will do the analyses needed to arrive at a good decision? While the process will require extensive participation of different functional areas of the business, it appears logical that accounting will bear the responsibility of bringing the analysis to an effective conclusion. This approach will allow accounting to become a partner in the strategic outsourcing process of a company.

Developing a successful outsourcing program is a little like making a soufflé. When done correctly, it is a masterpiece to enjoy. When done incorrectly, it is a mess to clean up.

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Perceptions of Online Classes

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ABSTRACT

Online classes can be defined as classes in which the instructors heavily rely on technology in order to convey information and teach their students, that might or not might be sharing the same room, or even the same geographical area. Furthermore, online classes have been classified under the same terminology as e-learning, which can be defined as “information and communication technologies used to support students improve their learning.” (Ellis, Ginns and Piggott)

Throughout the years, online classes have become more popular and “more than 200 institutions now offer online graduate degrees.” (Endres and Hurtubis) Many more offer online courses at undergraduate level to complete their academic offerings.

A survey was conducted of students who had taken both online and face to face classes. Results of the perception of the students are discussed and suggestions are made for delivery of online classes.

Introduction

During the last decade, the internet has become part of our culture and undoubtedly a new necessity in society. Since its release during the early 90's, people have started to rely more and more on online activities such as socializing and even using it to make monetary transactions, paying bills and checking their bank statements. It was just matter of time before the educational system adopted this new technology. Many colleges are using the internet not only to search for information, but also to communicate with their students and manage different activities of the academic life such as registering for classes or paying for tuition. However, colleges throughout America have taken a step further with the introduction of online classes. Online classes can be defined as classes in which the instructors heavily rely on technology in order to convey information and teach their students, that might or not might be sharing the same room, or even the same geographical area. Furthermore, online classes have been classified under the same terminology as e-learning, which can be defined as "information and communication technologies used to support students improve their learning." (Ellis, Ginns and Piggott)

Throughout the years, online classes have become more popular and "more than 200 institutions now offer online graduate degrees." (Endres and Hurtubis) Many more offer online courses at undergraduate level to complete their academic offerings.

However, unlike some predictions, online classes have not completely replaced face-to-face courses but have become a way of complementing them. Furthermore, different students see online classes as special opportunities according to their situation and background. For example, non-traditional students, working students, and students who are trying to balance family life with school, tend to rely more on online courses as they allow them to work towards their degree in a more flexible way and from their home.

On the other hand, regular students between 18 to 23 years of age tend to take online classes as a way to complement their face-to-face courses or to experience a new way of learning. However, up until now, it has been difficult to measure the value that online classes have in contrast to face-to-face courses.

The purpose of this exploratory study is to try to assess the perceptions that the students have towards online courses taking into consideration the different face-to-face courses they have taken in the past. The study compares, among others, the levels of difficulty, usefulness and convenience of online classes. The study conducted tries to measure the levels of motivation that students show towards online classes compared to face-to-face courses and analyze whether or not motivation affects the student's willingness to recommend online courses, or their desire to enroll in one.

METHODOLOGY

Survey was divided into several sections. First part had the filtering questions such as 'Have you ever enrolled in an online class' and other demographic characteristics. Part to focused on the differences between lecture classes and online classes with respect to attributes such as difficulty, stress, usefulness etc. Level of motivation was self reported, along with outcome such as learning. Next set of questions related to communication of material and feedback. Final section asked about their experience and if they would recommend the class to fellow students.

All the data needed was collected by using paper-based surveys that were proctored to students in classes selected randomly within the university located in southwestern part of the country. Professors from different departments were contacted and asked for permission to give out the surveys during the class period; diverse dates and times were given. Even though the classes were selected randomly, the majority of survey takers were junior or seniors. This fact might represent an important factor as juniors and seniors have been exposed to university and the survey was conducted in a summer session.

A total of 183 surveys were collected, 25 of those surveys were considered invalid according to different criteria such as excessive blank fields (greater than 30 percent incomplete and extreme tendency. Also, the surveys filled by students who claimed not to have taken online classes before were voided as they could not accurately compare face-to-face courses to online classes. Furthermore, surveys were also voided if the student constantly used the same ranking for different questions (i.e. filling out all "3" on one section.) After the tests for validity were applied and every survey was checked individually, we obtained 158 (86.33%) valid surveys that were used as a base for the study.

Preliminary Analysis

89% of the students were full time as this study was done in the summer session. 15.8% were sophomores, 19.6 percent juniors, 51.3 percent seniors (probably had to graduate). %5% of the students were between 21 and 23 years old. 51.8 percent were males, 66.5 percent were Caucasians, 77% had a job , 28.5% worked full time and 50.4 percent had a GPA over 3.0.

When one controls for GPA and number of hours worked there is a significant relationship between motivation, ease of learning and quality of course.

Only a quarter of the students found the online classes stressful. Majority of the students found the online classes equally difficult and felt they learned as much as a face to face classes.

Surprisingly two third of the students either disagreed or had no opinion about the courses being suitable to their learning styles. Interestingly half the students rather be in a classroom setting.

Females found online courses more useful than males. There were no differences on any of the attributes of online classes such as stress, ease, complexity, communication etc. between male and female students.

Gpa determined whether the students found the class easy and suited their learning style. Student motivation was a major factor in ease and usefulness of online classes.

There was a relationship between motivation, GPA, ease, usefulness, however there was no relationship with number of hours worked.

This is a very preliminary analysis. A complete analysis and a formal paper will be submitted if accepted. My apologies for lack of a good results and discussion section due to time constraints.

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How Chocolate Will Save Your Syllabus
A Workshop

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Catherine L. Franssen, Randolph-Macon College, Ashland, Virginia

In this workshop, attendees will participate in hands-on activities to learn how to engage students more fully in their own learning. Employing design-inspired approaches to contextual research methods and incorporating elements from neuroscience that explain why and how engagement occurs, increasing student involvement can be better understood. In addition, this approach can aid in identifying, quantifying, and measuring student learning outcomes. Evidence of use in an introductory Production and Operations Management course will be provided. Beyond use in the classroom, this effort-based reward approach will be explored in multiple applications.

Concentrations in Information Systems Degree Programs,

A Case Study

Educational Innovation

October, 2010

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Abstract

This paper discusses the need in recent years to reevaluate an Information Systems curriculum due to external pressures from rapid technology advancements and internal pressures of budget cuts and downsizing. This study was determined to retain multiple program options but in a simpler degree program offering.

Background

Traditionally Information Systems (IS) programs have been created in many and varied ways. This has caused some confusion in academia about how exactly an IS program should be structured. The prevailing idea has been that of organizations as information-processing or control systems (Galibraith, 1977) and IS curriculum was configured to accommodate this prevailing opinion.

Recently there has been a shift in curriculum focus due to the increasingly rapid pace of technology advancement. It becomes critical that faculty understand that there is no possible way to incorporate all the current technology into their curriculum (McFarland, 2003). The curriculum then switches from one of teaching what to do, to teaching how to do (McFarland, 2003).

Also traditional IS programs have been housed in the Business Department of most academic organizations (Hoganson, 2001). However, in recent years IS programs are moving away from strictly managing information to combining the more technical aspects of IS. This makes for a realignment of departments and a synergy between departments not previously known.

What used to be a simple matter of developing curriculum for IS, has changed drastically over the years as technology in organizations has changed. The demand for qualified IS employees continues to see steady growth, and academic organizations must keep pace. The problem then becomes one of meeting this challenge and overcoming external and internal challenges to solid IS degree programs.

Agreement on a definition of an IS program, even as recently as 2009, has not been widely accepted in academia (Murphy, 2009). What can be agreed upon is that an IS degree program must satisfy the needs of the industry, as well as, the needs of the student, while simultaneously meeting the needs of the academic organization.

Problem

The basic problem/challenge defined in this study is that in recent years, higher education has been hit with numerous budget cuts and the need to re-invent IS programs to meet current student needs. This has fostered an abundance of stresses that may contribute to faculty firings, retirements, and resignations, as well as, student losses.

A major part of these stresses is the threat of and/or decision to cut programs from the portfolio of a particular school, college, or university. In this scenario not only do faculty, staff, and institution lose valuable assets, but students also lose choice in their chosen career paths.

Solving this type of problem can only be achieved by re-inventing or re-engineering the policies and age old practices of providing separate degree programs. This is done by moving to a degree program that includes concentrations.

Curriculum Design for Information Systems Concentrations

Curriculum design for Information Systems Concentrations involves the following stages:

1. Research
2. Planning
3. Development

4. Refinement
5. Review
6. Acceptance
7. Approval
8. Implementation
9. Review and Refine

Each of these stages is addressed below and requires commitment from the Faculty through the Provost. The number of steps in each stage may be more or less depending upon the institution, but all stages must be completed for successful implementation of the new program.

Stage nine is completed once the program has been functioning for at least two academic years. This ensures that there are enough chances to see the program in action and to evaluate the effectiveness of the concentrations. Once an evaluation is made the cycle can repeat from one to eight for any changes needed to the concentrations.

01. Research

Research is very important to the process of developing a degree program with concentrations so that reliable information can be gathered from other institutions that have degree concentrations. Most appropriate would be institutions that have similar degree programs as being proposed.

Additionally, local IS industry partners can be solicited for their valuable input into the types of graduates they are seeking to hire. Both of these sources provide a better basis for the planning stage.

02. Planning

Planning is important so that ideas and thought can be developed collaborative between the principle participants in the degree development. Collaboration here may improve the viability of the program through later stages. Planning helps to avoid errors in development leading to unusable or unsuccessful degree programs, but instead gives a good blueprint for a successful program.

03. Development

Once the planning stage has been satisfied the development of the program may begin. This involves committing to paper the exact program envisioned during the planning stage. Here the goal is to produce a viable program that includes all of the concentrations that satisfy the needs discovered in the planning stage.

04. Refinement

Here the program is looked at logically and from a degree granting standpoint to determine if it meets the needs of students seeking this type of degree. A student oriented perspective here will also ensure that the program is viable.

05. Review

In this stage the program is given to a larger Faculty or Staff population for consideration. This allows for outside thoughts upon the type of program created. At this stage student involvement is recommended to ensure that the program is or will meet student's needs.

06. Acceptance

Acceptance comes from the direct participants of the degree program. These would be faculty, staff, and administration. Acceptance by these stakeholders is necessary to establish support for the degree program as it moves higher in the institutions approval hierarchy.

07. Approval

The approval stage is the last stage before implementation. This includes the Provost, the Chancellor or President of the institution, as well as, any other institutional organizations involved in the degree program.

08. Implementation

This stage has the degree program functioning with students enrolled and courses offered.

09. Review and Refine

This stage begins at the end of two academic years, to reevaluate the program for any changes, updates, or deletions that may be needed. If any changes are needed, then the process can begin again in stage one through eight.

Collaborative Concentrations

Consolidating separate programs into one program of study gives the opportunity for cross discipline collaboration within the concentrations. Collaboration will help students learn multiple disciplines without changing majors or degree programs. This would encourage cross-pollination of related disciplines leading to better, more rounded, graduates.

A Model Information Systems Program

B.S. Degree in Information Systems with Concentrations

A model Information Systems program recommendation will contain the following curriculum: (Topi, 2009)

Core Courses

Foundations of Information Systems

Data and Information Management

Enterprise Architecture

IS Project Management

IT Infrastructure

Systems Analysis and Design

IS Strategy, Management and Acquisition

However, the above recommended courses may or may not fulfill the needs of a particular program. Each individual academic organization must examine their skill sets, needs, and student expectations and modify the core courses to better fit with their academic organization's goals.

Case Study

The particular case study for a module curriculum for a degree program in Information Systems with Concentrations is outlined below. As a proviso for this model, be aware that it may only be pertinent to this program and this academic organization. However, it is believed that this module is very flexible and provides great opportunities for faculty and student program fulfillment.

Beginning in 2009 it was determined that the current Information Systems Degree program and the Web Degree Program contained many of the same courses and this commonality lead to a revisit of the two programs. Another contributing factor was the need to reduce the number of degree programs in the academic organization due to budget cuts. The budget cuts dictated a reduction in degree programs, without a reduction in faculty or staff positions.

Therefore a revision was needed to eliminate a degree program, but also to retain similar programs as we moved forward. Therefore we decided to utilize the degree program with concentrations model to make the transition. This had the advantage of creating several positive outcomes to include: (Murphy, 2009)

1. Simplifying the degree program for the student
2. Eliminating overlapping of courses

3. Meeting the needs of area employers
4. Attracting new students to the program

With these outcomes in mind, we developed the core courses listed here:

Computing Foundations and Ethics
 Application Programming
 Object-Oriented Programming
 IS Hardware and Software
 System Analysis and Design
 IT Project Management
 Database Management

In comparison with the previous core courses we find that they are very similar but also different. The result of this comparison is that while several courses topics match, there is flexibility in the differences.

Case Study Core Courses	Recommended Core Courses
Computing Foundations and Ethics	Foundations of Information Systems
Database Management	Data and Information Management
Object-Oriented Programming	Enterprise Architecture
IT Project Management	IS Project Management
IS Hardware and Software	IT Infrastructure
System Analysis and Design	Systems Analysis and Design
Application Programming	IS Strategy, Management and Acquisition

One of the differences in our core courses is that we chose to include programming courses. We determined that programming is an essential part of any Information Systems

program. The Object-Oriented Programming courses discuss the object-based method of programming widely used today.

Don Latham (Latham, 2002)] notes the value of programming in IS programs:

[S]ome knowledge of programming languages and database design can help the information architect to understand more fully the possibilities available for creating information structures. Such knowledge could also help the information architect be a more effective project manager in working with the computer programmers and database designers on the project team. An understanding of information systems, both the hardware and software components, would be useful as well to the information architect involved in implementing and maintaining a content management system.

Additionally, we found that in the future we may have to adjust the core courses, but with the rest of the program courses neatly nestled in concentrations, we would be able to make changes without greatly affecting the program. Flexibility is the key to improving our program but still retaining the ability to make it meet our academic organization goals.

While the core courses are listed above the major degree courses and concentrations are listed in Appendix A. This program then becomes the basic model for the collaborative degree as we envisioned in our case study.

Conclusion

The conclusion we have reached in this study is that there is great flexibility without consequence to creating an Information Systems Degree Program with Concentrations. The ability to offer familiar courses, and retain faculty and staff is most encouraging. The academic organization maintains its faculty, and staff, and students retain their ability to choose several areas of study.

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Appendix A

Information Systems Degree Program with Core and Concentration Courses

Core Courses	Credit Hours	
Principles of Accounting I	3	
Principles of Accounting II	3	
Business Law	3	
Principles of Management	3	
Corporate Finance	3	
Marketing	3	
Engineering Economy	3	
Computer Foundations and Ethics	3	
Database I	3	Concentration Areas
Networking I	3	
OO Programming I	3	
Web Technologies I	3	
IS Hardware and Software	3	
Systems Analysis and Design	3	
IS Project Management	3	
Database Concentration		
Information Security	3	
Introduction to Unix	3	
Database II	3	
Database III	3	
Electives	12	
Networking Concentration		
Information Security	3	
Introduction to Unix	3	
Networking II	3	
Networking III	3	
Electives	12	

OO Programming Concentration		
Information Security	3	
Introduction to Unix	3	
OO Programming II	3	
OO Programming III	3	
Electives	12	
Web Concentration		
Internet Marketing	3	
Web Technologies II	3	
Web Technologies III	3	
Desktop Publishing	3	
Digital Illustration	3	
Graphic Design	3	
Digital Imaging	3	
Electives	12	
Total Credit Hours - Major w/Concentration		69

INNOVATION - IMPLICATIONS FOR MANAGEMENT EDUCATION

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Abstract

In April 2010, the AACSB International Task Force on Business Schools and Innovation, released its report ‘Business Schools on an Innovation Mission.’ The report proposes a working definition of innovation and concludes with five recommendations. This paper reviews the committee’s report and recommendations to explore the implications of the AACSB’s task force recommendations for business education.

The objective of this paper is to identify the challenges and opportunities facing business schools as they contemplate the implications of innovation and the AACSB’s Task Force recommendations. This article suggests that the recommendations of the AACSB Task Force on Innovation’s report has major implications for the future of management education. In responding to the AACSB’s April 2010 report, this article proposes several courses of action.

AACSB Task Force

The AACSB Task Force on Business Schools and Innovation was commissioned by the Board of Directors of the AACSB. Members included:

- Robert S. Sullivan, Chair. Dr. Sullivan is Dean and Stanley and Pauline Foster Endowed Chair of the Rady School of Management, University of California, San Diego
- Debra J. Cohen, Chief Knowledge Officer, Society for Human Resource Management
- Scott S. Cowen, President, Tulane University
- Robert J. Doan, Dean, Stephen M. Ross School of Business, University of Michigan
- Stuart I. Feldman, Vice President Engineering, Google, Inc.
- Fernando Fragueiro, IAE Business School, Universidad Austral, Professor of Organizational Behavior and Director of the CEDI Research Center
- Sara M. Freedman, Dean, William S. Spears School of Business Oklahoma State University
- Donald C. Hambrick, Smeal Chaired Professor of Management, Smeal College of Business, Pennsylvania State University
- Daniel R. LeClair, Vice President and Chief Knowledge Officer, AACSB International
- Linda A. Livingstone, Dean Graziadio School of Business and Management, Pepperdine University
- Mari A. Pearlman, President, Pearlman Education Group, LLC
- Christopher P. Puto Dean, Opus College of Business, University of St. Thomas - Minnesota
- Yingyi Qian, Dean School of Economics and Management, Tsinghua University

- Hans Wiesmeth, Dean HHL - Leipzig Graduate School of Management

Listing the names and titles of each participant reveals that the group not only consisted of prominent AACSB includes leadership in innovation from the corporate sector. Nor was membership limited to US nationals. The task force included participation from countries around the world. This diverse group was charged with defining innovation and exploring its implications for management education.

During an April presentation on the role of the task force at the AACSB's Deans Conference in Tampa, Dean Sullivan explained that the Board of Directors was concerned that neither politicians nor corporate or trade associations invited the AACSB International or any business school "to the table to input on various pronouncements concerning innovation as a strategy for economic recovery." The potential contribution of innovation for sparking economic recovery is a central theme of the AACSB report released in April 2010. Many organizations, politicians, economists, media commentators and even the past three Presidents have promoted the concept of innovation as critical to the recovery of the global economy. The fifth Clinton Global Initiative Annual Meeting in September 2009 featured the theme of innovation. The World Economic Forum in Dalian's main speaker, Chinese Premier Wen Jiabao pledged to transform China into an "innovative nation." The US Chamber of Commerce, the National Federation of Manufacturers and other trade organizations have promoted innovation as a necessary ingredient to economic recovery. The AACSB Board of Directors lamented that the premiere accrediting organization for management education had not been approached on the topic of innovation. The AACSB Board of Directors decided that it was time to draw attention to this topic. The AACSB Board organized a task force to explore the implications of innovation on business schools and the opportunity for business schools to incorporate innovation in their mission, curriculum and eventually in their publicity.(Sullivan 2010)

"The role of business schools in supporting innovation remains underdeveloped, undervalued, and too-often unnoticed" states Andrew J. Policano in the introduction to the final report. Dr. Policano was Chair of the Board of Directors, AACSB International and Dean of the Paul Merage School of Business at the University of California, Irvine. The report makes the connection between innovation and management education by stating that "innovation is as much about leadership and management as it is about science and technology." (Sullivan 2010).

Framework for Understanding Innovation

The Task Force promotes an expansive definition and commentary on the nature of innovation. They rejected traditional definitions where innovation is attributed to the need to pursue profits and is tied to entrepreneurial activity to harness scientific and technological developments or inventions. This expansive definition recognizes that innovation is pursued by a variety of organizations beyond the private sector and that innovation is relevant to a variety of organizations that include governmental agencies and non-profits. Rather than viewing innovation as an invention or a specific advancement in technology, the committee notes that innovation involves both technological and managerial issues. The authors noted that "one of the roles of business schools must be to teach the skills necessary to successfully bring technological breakthroughs to market."(Sullivan 2010) They also challenged the premise that somehow innovation and entrepreneurship are equivalent. Not all "start ups" are innovative. The report acknowledges that entrepreneurship and innovation "are deeply and inextricably connected" and that the distinctions between the functions of management and entrepreneurs have been fading" ... and "Increasingly, managers in established organizations are expected to behave like entrepreneurs and entrepreneurs to behave like managers." (Sullivan 2010)

The Task Force advocates that "one of the roles of business schools must be to teach the skills necessary to successfully bring technological breakthroughs to market." (Sullivan 2010) While the report did not

give an example, one only has to look at a program at Baylor University, Waco, Texas. Called the International Interdisciplinary Innovation program (I5 program) five universities: Baylor, American, Thunderbird, University of Shanghai for Science and Technology, and Hong Kong Baptist University collaborate to bring students to China to work with Chinese companies for five weeks helping to bring practical business solutions. (2010) The authors stress that having opened the issue of innovation beyond the realm of business, the notion that innovation is limited to those who are inventors or scientists is too narrowing. They proposed that “by definition innovation requires implementation.” And that “Recent research shows managers to be essential, active, and inextricable players in the process of innovation.”(Sullivan 2010)

An article in *European Journal of Engineering Education* describes an example of experiential learning where engineering students were involved in a research project to combine membrane technology with renewable technology to forge new solutions to providing drinkable water. The authors noted that “Such initiatives offer an exciting addition to the environmental engineering curriculum and can be adapted to various teaching frameworks and topic areas. In addition to acquiring technical skills, the students gained skills in the areas of teamwork and interpersonal skills, project management, interdisciplinary skills, and confidence in interacting with non-engineers.” (Schäfer and Richards 2007)

The report cites recent research which suggests that “innovation does not just happen; it is created through complex interactions and decisions among people within and between organization.” Citing a 2009 report *Management Matters* by the Ontario-based Institute for Competitiveness and Prosperity (led by the Dean of the Rotman School of Management at the University of Toronto), the task force presents the observation that managers play a critical role in funding, marketing and driving the process of innovation. This report argues that Canada needs to strengthen its management pool. (Sullivan 2010) A second model is based on Amar Bhide in his book *Venturesome Economy* where the Columbia business professor argues that managers possess specific knowledge essential to the implementation of breakthrough ideas. Bhide argues that success in business resides in application of breakthrough ideas rather than their creation. And the Task Force concludes that “Enterprising and discriminating managers, willing to take risks by buying new products or investing in new productive technologies, are important drivers of the demand for innovation.” (Sullivan 2010)

A third model suggests that managers should be seen as organizational architects who build and embody the “dynamic capability” required to succeed. The argument is that new technologies may require new organizational and institutional arrangements to be feasible in the marketplace. The AACSB report cites an article by Professors Mie Augier and David Teece in *Organization Science* that concludes that in environments that have frequent changes, an organization’s success depends less on its position relative to external forces “than on its internal capabilities... and that innovation requires excellent execution, strategic thinking, and effective management knowledge workers and entrepreneurship.” (Augier 2009) (Sullivan 2010)

A fourth model is based on the premise that management innovations are important drivers of business success and are largely the responsibility of managers. In this model, management innovation is as important as product innovation in creating value. The Task Force report notes that Wal-Mart’s success lies not in its inventions but in management’s innovations in all phases of its operations. While Wal-Mart is in the retail industry, its management has been very successful in implementing innovation in logistics, marketing, computer information systems, etc that has delivered extraordinary growth and profitability. (Sullivan 2010)

Their fifth model is based on Manager as Bridges who facilitate and engage in boundary-spanning networks that contribute to innovation. This approach suggests that managers who have large

professional networks and maintain a broad spectrum of knowledge across many business disciplines are likely to be able to acquire knowledge that is useful in promoting innovation.

The discussion of the five models of managers gives “a picture of the responsibility business schools have in preparing managers and entrepreneurs to inspire, implement, and create innovation.” (Sullivan 2010)

In a chapter titled “The Role of Business Schools in Innovation, the Task Force constructs a framework that places business schools at the center of the innovation process in the context of teaching, research and outreach depending on the overall mission (teaching, research, etc) of the school. They acknowledge there is no “single formula on how to address innovation” and suggest that within the context of each business school’s mission, each institution is free to develop their own innovation objectives and activities that best fit their communities. In terms of skills versus transferring knowledge, neither the Task Force nor the AACSB are attempting “to dictate what should be taught in business schools about innovation.” But the report does assert that management education should focus as much on developing skills as transferring knowledge.”(Sullivan 2010) The report makes the following observations:

- Innovation requires more integrative thinking and integrated curricula.
- Executive non-degree education programs are especially well-suited to supporting innovation.
- important impacts on innovation can come from advances in the theory, practice, or teaching of management, but intellectual contributions do not have to be revolutionary to support innovation
- Because the roots of the innovation research have already cut across organizational functions and industries, interdisciplinary research into management innovation should do the same by involving faculty from multiple disciplines.
- Business incubators play the most direct role in support of innovation especially in the local communities served by business schools.
- Business schools can and do work with other colleges and schools within the institution to create unique programs to support innovation.
- Business schools should not ignore the importance of other activities such as alumni relations, which can contribute significantly to innovation through social capital development. (Sullivan 2010)

There is little doubt that the composition of the task force (with participants from industry who are working for organizations known for their innovation (like Google), and individuals who market their expertise in coaching individuals and organizations on innovation), explains their approach in developing a conceptual framework on innovation and drawing recommendations from that framework. The task force divided their recommendations or conclusions into two groups: recommendations on the role of business schools and recommendations on the role of AACSB International. On the role of business schools, they should develop and regularly evaluate their contributions to innovation in society; develop an approach for creating value at the intersection of different perspectives; and they (business schools) should advocate for their role in innovation. On the role of AACSB, the task force recommends that AACSB should determine the appropriate balance of collective pressure and support such that business schools advance innovation in society; and AACSB should determine the nature and extent of its advocacy role, especially as it relates to business schools’ support for innovation in society.

Implications for Management Education - Challenges Ahead and Proposed Strategies

The AACSB Task Force’s report concludes that management education can play a positive role in advancing innovation resulting in economic recovery. Management needs to better understand innovation in order to harness it for the betterment of their organizations. One of the challenges facing business school faculties is in deciding how and what to integrate into the curriculum on the subject of innovation. On one level the challenge is to define what business skills enable future managers to efficiently,

ethically, and effectively harness innovation for the benefit of society and their organizations. As previously noted, entrepreneurship programs and travel abroad programs have a potential to offer to experiential learning related to innovation depending on the organization and structure of such programs. However, unlike traditional courses, there is a lack of academic consensus on the elements or learning objectives for the field of innovation. The subject is so new that even the AACSB's Task Force noted that most of the literature on the subject of innovation is relatively recent. The report urges business schools to encourage more research on the subject. (Sullivan 2010)

The AACSB has announced its commitment to promoting innovation by urging business schools to incorporate it in their mission statements because it is vital for economic recovery. However, the fact that half of the report is spent on defining innovation as a management skill suggests that business schools have a long way to go to really identify the intellectual and experiential core that students need to acquire. How are business schools to assess their efforts in promoting innovation management skills? In order to develop assessment tools, professors will first need to determine the knowledge on innovation that is needed to become effective managers of innovation. What are the skills need to effectively deal with chaos, uncertainty and rapidly changing economic environments? Unlike the discipline of accounting where there general agreement that all students need to understand the double entry bookkeeping system, the basic financial statements, the aggregation of information needed to create those statements, and the regulatory framework of disclosures, there is no consensus on this emerging issue of management innovation from either a skill based or knowledge based perspectives.

In making the above observation, it is important to distinguish the difference between skills and knowledge-based information. For example, getting on a ski slope or on a pair of water skis is the result of experiential learning and developing the skill set of balance, endurance, etc. That is very different from memorizing all the championship competitions. There is a considerable difference in preparing to become competitive athletes and becoming sportscasters through there are clearly overlapping areas of knowledge needed by both athletes and sports announcers. Watching hundreds of hours of videos depicting snow skiing or water skiing competitions does not impart the ability to snow or water ski. As in the area of accounting, we have consensus that accounting majors must have a more rigorous, technical understanding of accounting theory. General business students who are not likely to work in an accounting department need to know how to interpret and use financial statements in making business decisions. In this emerging field of innovation education, there is a need the core components of managing innovation.. Rather than starting from scratch, business scholars might well want to review research from other disciplines. Sister disciplines such as industrial psychology, child-adult intellectual development (education), medical brain research and even the arts (developing personal creativity) offer useful perspectives on innovation from both skill and knowledge perspectives. To fully achieve an outcome where business education fuels innovation, we face an enormous challenge of further strengthening our ability to work across many disciplines while we develop more management theory on innovation.

Another critical challenge stems from the reality that professors teach what they know or have experienced. The entire concept that there is a set of management skills related to innovation to be shared with business students is going to be very difficult to realize if professors have not had either formal education or experiential opportunities in innovation. One might even argue that with the exception of some faculty that have a background (either education or experience) in organizational behavior or in entrepreneurship, few have the theoretical underpinnings related to innovation even if we had a fully developed definition of skills sets and knowledge critical to promoting innovation. While universities talk about faculty development, the reality is that especially when university budgets are tight, there is little in the way of support to fund sabbaticals, travel for conferences other than for the purpose of presenting research, and grants to fund collaborative, interdisciplinary research. On the other hand, one

innovative approach might be for universities to aggregate scarce research funds to harness intellectual capital from competing institutions by setting up research teams.

Another challenge is to define what knowledge or substance needs to be taught in order to produce a graduate proficient in managing positive change and innovation? In conducting research on this topic, I found many experiential learning opportunities involving students working on teams to commercialize technology in both large and small organizations, in both new and well-established organizations. What is sparse, however, is exactly what substantive knowledge must we provide to future managers that will help them develop needed skill sets in managing innovation? As the report frequently urges, more research on innovation and the proper intellectual framework is needed to produce a body of knowledge on innovation that will build both managerial competence and advance innovation for the organization regardless of its mission. Such research takes time. And it takes coordination to realize the interdisciplinary nature of the topic. Meanwhile, it is clear from the report and the stature of those serving on the task force, that the AACSB will be moving toward exploring the issue of how much “push” from the Accreditation Committee versus mere “support” of innovation. Will the Accreditation Committee formally use its leverage on business schools to incorporate or integrate innovation into their mission?

Strategies for Implementation

In pondering the implications of recommendations of the AACSB Task Force on Business Schools and Innovation, the recommendations are straightforward as to their desired outcomes, but the path towards those outcomes are unclear. Nor does the report suggest assessment tools that would indicate when the desired outcomes have been reached. This article offers suggestions concerning implementation strategies with the hope that greater minds will respond and help institutions develop practical and cost effective approaches to the challenges ahead of us.

One strategy toward implementation of the recommendations of the AACSB Task Force is to create an intellectual inventory of existing programs and resources used outside of academe to promote innovation. All too often those in management education have announced an initiative and plunged into the process of developing our own approaches without thoroughly investigating what progress has been made both within and outside of academe. One example is the AACSB efforts on assessments of learning. When the AACSB decided to incorporate assessment of learning goals into our accreditation standards, it seemed to many faculty that we totally ignored the body of research and experience found in most Colleges of Education. Instead, the business school mentality was too much “not valuable if not invented here.” The same is true of our initiative to incorporate and use technology to improve instruction. That effort was kept within the confines of business schools when next door in colleges of education, instructional technology programs and research has been core to their mission just as accounting, finance, marketing, management and law are core elements of our business curriculum. Those who carefully read the AACSB Task Force Report on business schools and innovation will note that the recommendation strongly urge business schools to take an interdisciplinary approach to innovation. I am not saying that those on the task force would concur with my observation that we tend to “reinvent the wheel” with my examples above, but the Task Force definitely supports the contention that innovation is a cross disciplinary concept. Therefore building an inventory of organizations and programs that promote innovation education should be a first step.

A very “light” and preliminary research effort revealed that there are many organizations that claim to have the answer as to how to train enlightened leaders capable of handling innovation. What does it take to develop enlightened leaders who can transform their organizations and communities? An article in the *Journal of Management Education* describes one academic program that attempts to fulfill that mission. “The goal of a Masters of Science program in Executive Leadership is designed to develop enlightened leaders who are self-aware, learning centered, adaptable, interpersonally competent, and team oriented is

a challenge faced by many management programs. The Master of Science program in Executive Leadership and Organization Change (ELOC) was designed to develop enlightened leaders who can demonstrate outstanding and transformative leadership in their organizations and communities. The ELOC program is an innovative executive-level master's program designed to develop leadership and change management skills through the pedagogical framework of ACT (action learning, competency development, and teamwork). ELOC students participated in a public engagement practicum course in the first summer of their program.” (Rhee and Sigler 2010) Another example is from the South Western Sydney Institute which offers a Graduate Certificate in Management of Innovation.(2010) In the United States, North Carolina State University created the Innovation Management School (IMS) as a partnership between NC State University and the Industrial Research Institute. This program was mentioned in the Task Force report. Carnegie Institute of Technology along with Heinz College, Social and Decisions Science Department, and the Tepper School of business offer a Masters program in Innovation Management. (2010) By no means is this a complete listing of academic offerings in innovation.

In addition to academic institutions, there are many professional or trade associations that offer certificates or courses in innovation. The American Society for Training and Development claims to be the largest organization for training professionals and offers books and seminars (both in class and on line). (2010) The United States Air Force Institute of Technology offers courses on innovation. (2000) as do the other Armed Forces through their graduate management programs.

While there is a growing number of articles on innovation published in scholarly, refereed journals, this is a relatively new area within business or management journals. However, a search through Google reveals a plethora of resources on innovation. Commercial organizations like Eureka Ranch are offering innovation management seminars, consulting services on how to commercialize new ideas into products and services. IDEO is a global design consultancy that offers design services in a way that promotes innovation. An example from their role in designing for innovation is taken from their web site was the design of the Prius which incorporates a screen on the dashboard that actually cause drivers to think about their driving habits in terms of energy consumption (www.ideo.com). Innovation Labs is a firm that offers consulting services based on their Innovation Master Plan which they describe as a framework that “guides your efforts in three critical areas: Policies, Practices and Know-How. (2010) They developed “concept cards” which they use to help clients develop innovative insights which sparks innovation by their clients. (Kaufman 2010) Bottom Line Innovation Associates, Inc. was founded by the former head of DuPont ‘s Center for Innovation and Creativity. This organization offers consulting and instruction for companies and organizations seeking to promote innovation. (Prather 2010) Innovation Point Inc. is focused on strategic innovation focusing on opportunity identification, new business creation, strategy development and new product, service and category innovation. Their web sites explains that they focus on organizational structures, processes and cultures that tightly align to business strategy to create sustainable innovation. (Kaplan Ph.D 2010). There were roughly 2,460,000 results using the search “innovation consultants” in Google.com. The point is that while academic literature may be currently a little sparse, there is a huge amount of material on innovation written by private firms some of which have been tested by the marketplace. In a quick search through the listings of consulting firms, it is interesting to discover that quite a few firm principals have earned Ph.Ds and many of those either have or are currently teaching as adjuncts.

In the early days of teaching entrepreneurship professors were faced with a barrage of hostility toward the notion that people who successfully start businesses must have a particular DNA and that such skills cannot be taught. Fortunately, this debate should be minimal as the concept of teaching creativity and innovation is more broadly acknowledged. Michael Moscovsky writes that innovation can be taught just as effectively as any other skill. (Moscovski 2009)

An inventory of existing programs and research on innovation should also include federal programs that advance innovation. Governmental programs such as the National Institute of Standards and Technology (NIST) Technology Innovation Program (TIP) which was created on August 9, 2007 when Congress passed the American Competes Act. NIST is a federal agency within the US Department of Commerce with the mission of “promoting US innovation and industrial competitiveness by advancing measure science, standards and technology in ways that enhance economic security and improve our quality of life. Since its inception in 1990 and during the 44 competitions that were held between 1990 and 2004, 768 ATP projects were selected, of which 224 projects (30 per cent) and \$ 620 million of federal funds involved biotechnology and or healthcare-related technologies.(Klein). Innovation programs and departments are sprinkled throughout the federal government. In 2009, the Secretary of Commerce announced the creation of Office of Innovation and Entrepreneurship within the Department of Commerce and launch a National Advisory Council on Innovation and Entrepreneurship. “Both substantial new initiatives will help leverage the entire federal government on behalf of promoting entrepreneurship in America.” (Release 2010) The Small Business Administration offers a program that provides funding for innovation to small businesses. (2010)

To speed the implementation of innovation education within business education, a collaborative effort to make an intellectual inventory of programs, courses, and research on innovation might be very productive. This inventory should be made available to those professors seeking to research the subject. In a time of constrained resources, as a profession, we should be efficient in designing our research agenda to actually deal with issues that will be useful and contribute to our institution’s mission.

A second strategy is to develop a forum to examine different models for injecting innovation into the business curriculum. One model is to develop stand alone courses in innovation just as was done when international business was introduced to the business curriculum and when business schools confronted the for ethics in management education. The other alternative is an integrative model. Some institutions inject learning goals and specific case studies or lectures on ethics within courses such as accounting or finance. Some institutions will try injecting innovation theory and practice into existing courses or they may create stand alone courses in managing innovation. Critical to this effort is the need to develop assessment tools to measure student learning. It may well be more efficient to have AACSB faculty propose forums, seminars and conferences on innovation within their particular academies.

A third strategy is based on the reality that faculty teach best what they have been taught or experienced. While there are a number of adjunct and full time faculty that have experience in managing innovation or formal education on the subject or both, the majority of faculty do not have that orientation. One of the more interesting admissions by the Task Force is that much of business education is linear and organizationally focused. Few courses other than entrepreneurship deal with the issues of managing in an environment of uncertainty and chaos. Much of our research methodology is based on the scientific method and relies heavy on quantitative approaches. Although we do use the case study method to demonstrate application of methods and strategies, we do not give a broad and integrative “context” to our future business leaders. The liberal arts courses supposedly provide that context but in reality students do not generally integrate information across courses much less longitudinally. Once a course is over, we encourage the sale of textbooks which conveys the message that the course is done, over, and irrelevant to other courses. While economics supposedly teaches some “macro” perspective, most economists convey the “history” through graphs which doesn’t completely convey cultural, ethical and historical context to the analysis. Most business curriculum does not include any business history courses.

When talking about innovation skills, much of the literature suggests that visualization and use of the non-quantitative portion of the brain contribute to creativity. However, in requiring students to take a course in art, we impose a totally passive course in “art appreciation.” Perhaps it is time to question the

array and type of courses we are requiring outside the business curriculum. Do we need to analyze the value of art appreciation as opposed to a course where students would exercise the “other half” of the brain in drawing or sculpture that would promote exercise in visualization which some innovation trainers suggest is a valuable skill. When we offer courses that require that students debate, are we missing the opportunity to train students in collaborative skills to conduct brainstorming sessions? When AACSB institutions started to add critical thinking skills as a learning goal, that required a serious review of the difference between obtaining knowledge from memorization and actually expecting our students to apply their learning to solve particular problems. The third strategy is to look at exactly what skills are required to effectively manage innovation and how can courses outside the business curriculum help in developing those skills.

To promote efficient and effective strategies related to moving forward with the AACSB report, I was invited to establish a blog or discussion board on the AACSB Exchange under Innovation. Given the demands on our time as faculty, few of us have the time to pontificate on the subject of innovation. However, other organizations and forums should be promoted so that regardless of our background or experience in managing innovation, we might encourage intellectual inquiry on this topic and its relevance to management of innovation. It may well be that AACSB will start hosting seminars and programs on innovation that will stir our intellectual curiosity on the topic so that faculty can improve our knowledge and perhaps gain some experience in this area. One forum might be devoted to showing innovation in each of our disciplines. A friend of mine suggested that recognition is the first step in comprehending the opportunities for innovation. He gave me the example of the impact that electronic spreadsheets had on merger and acquisition activity. When consolidated financial statements reflecting potential mergers had to be done manually, the process could take months of expensive accounting staff to create pro formas. With the advent of spreadsheets M&A firms could crank out “what ifs” within seconds. As a result, the volatility and pace of mergers jumped to records levels of activity. While is beyond the scope of this paper or the charge given to the AACSB Task Force on Business Schools and Innovation to consider the specific implications of innovation on course content, our academies should perhaps convene programs or sections to further investigate this issue.

Conclusion

The expression “the devil is in the detail” certainly applies to implementing the recommendations and conclusions of the AACSB International Task Force on Business Schools and Innovation. This review of the report titled Business Schools on an Innovation Mission summarizes not only the recommendations but more important reviews the conceptual framework and strategic positioning of business schools contemplated by the task force. Pulling the concept of innovation away from strictly the issue of technology, advocating innovation as a management skill and process and not simply managing high technology commercial enterprises but seeing innovation as a concept applicable to the widest variety of organizations, and inviting business schools to integrate innovation into the mission statement has profound implications for management education. The report challenges both business schools and the AACSB International to elevate innovation as a core management education concept that must and can both draw on other disciplines while at the same time give our business schools an incentive to form more intellectual bridges across campus as well as with other businesses, non-profits and governmental organizations.

The modest proposals address the issue of what strategy should business faculty and AACSB consider in responding to the opportunity to deepen management education’s recognition that innovation entails both a skill set and a body of knowledge that can have significant impact on society and on both local and global economies. Creating an intellectual inventory of academic, trade and commercial education, research and experiential strategies to improve individual and organizational innovation may well speed up consideration of what programs and activities might be incorporated to improve management

education. Identifying organizations and programs that conduct existing innovation consulting and training is essential to avoiding the exercise of “reinventing the wheel.” Recommending that management faculty be given opportunities to expand their own personal education, training and experience in managing innovation is simply a recognition that faculty teach best what they know or have learned or better yet have experienced. Looking broadly at other course work through the undergraduate and graduate curriculum that is not strictly under the control of the business school is a valuable exercise. The selection of mandatory “liberal arts” courses is related to providing students with the potential of acquiring both innovation skills and knowledge is a worthwhile activity. Such encouragement of faculty to engage in the discussion over the design of curriculum and selection of coursework outside the business school should enhance a business school’s external and internal relationships and place our business schools at a seat at the table of discussion on the issue of how we can stimulate our economic recovery. Finally, it is essential that this initiative to recognize innovation as a management skill where effective assessments can be made to continuously improve the value of management education for all society and not just the business community. Defining effective management practices, providing a sound basis of knowledge for ethical decision making, and giving business students and future business leaders the capacity to deal with chaos, constant change and uncertainty will benefit all everyone throughout the world. The challenge is before us and the reward quite generous for the faculties and institutions who actively participate on a journey that may well significantly transform and improve business education.

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TEACHING COST ACCOUNTING: ALTERNATIVE METHODS FOR CALCULATING EQUIVALENT UNITS

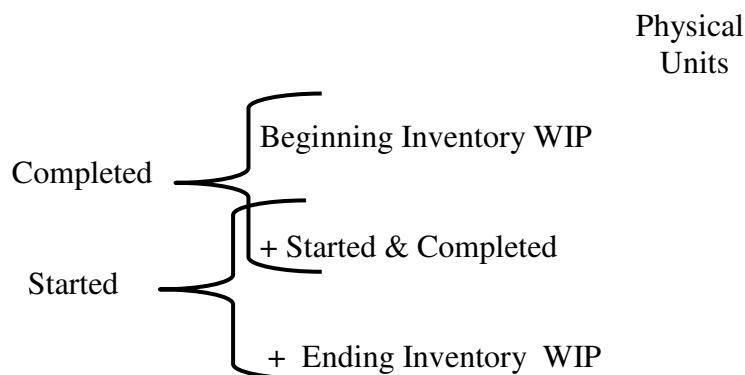
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INTRODUCTION

A graduate level managerial/cost accounting course is a required course in most MBA and Masters of Accountancy programs. The course usually focuses on a variety of topics, including job order and process costing. In process costing, students are equally likely to have encountered one of two techniques for calculating equivalent units of production in their prior exposure to process costing, whether it was only in principles of accounting classes (for most MBA students) or principles plus an additional course in cost accounting (for Masters of Accountancy students). Students with prior exposure to one method of calculating equivalent units who are then presented the other method (with no mention of the alternative technique) can feel that the way they are currently seeing presented is perhaps inaccurate since it differs from the way they were originally taught. Alignment of the similarities and differences between the two techniques can be important in not only learning the material, but also in serving future clients who may use either technique. Accordingly, both methods are presented and discussed in the following sections.

OVERVIEW OF CALCULATING EQUIVALENT UNITS OF PRODUCTION

Students first need to be reminded that the term “equivalent units of production” means the equivalent number of whole units produced during a certain time period. For example, if one-half of the work was done on 100 units, that would be equivalent to 50 whole units produced. Next, students need to be cautioned that there are three potholes on the road to successfully calculating equivalent units of production. The first pothole to avoid is the confusion in correctly classifying physical units (both partially and fully completed units) into the following five categories: Beginning Inventory Work-In-Process (BIWIP), Ending Inventory Work-In-Process (EIWIP), units started (S), units started and completed (S&C), and units completed (C). It should also be noted that other names can be used to label the physical units. For example, units started and completed could also be called units started and finished. Units completed can also be called units completed and transferred, units finished, or units finished and transferred. These relationships can be shown as follows:



There are various equations that are often used to show these relationships, such as:

$$\text{Beginning Inventory WIP} + \text{Started} = \text{Ending Inventory WIP} + \text{Completed}$$

$$\text{Started and Completed} = \text{Started} - \text{Ending Inventory}$$

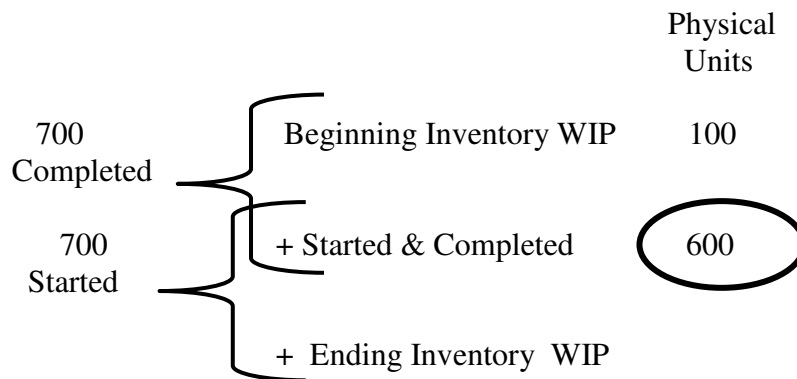
Or

$$\text{Started and Completed} = \text{Completed} - \text{Beginning Inventory}$$

An example can often highlight the trickiness of avoiding this pothole:

Suppose Z Company had a beginning inventory of 100 units. During May, 700 units were started and 700 units were completed. Therefore, the number of units both started and completed during May were:
 A. 1,400 B. 700 C. 800 D. 600 E. None of the above

By plugging in the numbers, it can be seen that the answer is D. 600 units.



What this means then, (and this is the tricky part) is that the number of units started plus the number of units completed does not equal the number of units both started and completed. This always causes students to do a double take – so it is important to then insert the numbers – the number of units started (700) plus the number of units completed (700) for a total of 1400 units does not equal the number of units both started and completed (600). This does get the students’ attention and does alert them to be careful to avoid pothole number one – because if a mistake is made here at the beginning, all the other numbers, no matter how meticulously calculated, will be wrong.

The second pothole to avoid is to be sure to accurately calculate equivalent units for materials added at different points in the production process. The information in process costing problems usually states the percentage of completion for beginning inventory WIP and for ending inventory WIP. For example, suppose beginning inventory WIP is 40 percent complete and ending inventory WIP is 30 percent complete. Students need to be reminded that these percentages apply only to items added evenly – usually direct labor and factory overhead – also known as conversion costs of production. If materials happen to be added evenly, the percentages would then apply to materials, too. However, materials are usually added in a different pattern – and thus the pothole to watch for and avoid. In textbook problems, materials are almost always added at the beginning, with sometimes a second type of materials added at the end. Students need to become comfortable with the fact that materials added at the beginning of production will be 100 percent complete, no matter how complete the production process is. In this

example with beginning inventory WIP being 40 percent complete – if materials are added at the beginning, 100 percent of the materials have been added even though production is only 40 percent complete. A good example to use is the lighting in the classroom. If all the lights are turned on when someone enters the room (at the beginning of production), then even if someone is only 40 percent of the way around the room, 100 percent of the light is present. Alternately, if materials are added at the end of the process (such as being put in a big red box), then even if production is 40 percent complete, zero big red boxes have been added.

The third pothole relates to beginning inventory WIP. As in the example above, if beginning inventory is 40 percent complete, it must be remembered that the 40 percent that is complete (for items added evenly) is from work done in the last time period. The work done this time period to complete the production is not the 40 percent – but the other 60 percent. With materials added at the beginning, 100 percent would have been completed during the last time period, so zero would need to be added to complete production this time period. If added at the end, zero materials would have been added last time period and 100 percent would need to be added this time period to complete production.

TWO ALTERNATIVES FOR CALCULATING EQUIVALENT UNITS OF PRODUCTION

There are two alternatives that are generally used to calculate equivalent units of production. One of the procedures incorporates the analysis used in the section above for properly aligning units in beginning inventory WIP, ending inventory WIP, units started, units completed, and units started and completed. The second procedure does not use this exact alignment. However, the second procedure does arrange the data in a way that avoids the dangers of pothole number three mentioned above. The two methods will give the same answers for equivalent units, and will be illustrated through the use of the following example:

The Ocean Tide Company operates under a process costing system and has one department where no spoilage, waste, or shrinkage is assumed to occur. The following information is available for May:

Work-In-Process Items	Units	Percent Complete	Materials	Labor & Overhead
Beg. Inventory	5,000	40%	\$20,500	\$ 6,460
Current Costs			\$51,000	\$28,800
End. Inventory	8,000	30%		

Additional Information:

1. 9,000 units were started and completed during May.
2. Materials are added at the beginning of the process.
3. Conversion costs are added evenly.

Calculation of the equivalent units of production can be done by using one of the two following alternative frameworks:

ALTERNATIVE 1 FOR CALCULATING EQUIVALENT UNITS

		Physical Units	Materials	Labor & Overhead
Completed				
Started				
Equivalent Units				

ALTERNATIVE 2 FOR CALCULATING EQUIVALENT UNITS

	Physical Units	Materials	Labor & Overhead
Completed			
+ Ending Inventory			
Subtotal			
- Beginning Inventory			
Equivalent Units			

↑
Started

Substituting in the data for Ocean Tide Company yields the following results:

ALTERNATIVE 1 FOR CALCULATING EQUIVALENT UNITS

		Physical Units	Materials	Labor & Overhead
14,000 Completed		5,000	-0- (2)	3,000 (3)
17,000 Started		+ 9,000 (1)	+ 9,000	+ 9,000
		+ 8,000	+ 8,000 (4)	+ 2,400 (5)
Equivalent Units			17,000	14,400

(1) Units Completed = BIWIP + Started & Completed
 $14,000 = 5,000 + \text{Started \& Completed}$
 $9,000 = \text{Started \& Completed}$

(2) BIWIP was 40% complete and contained 100% of materials; therefore, -0- was added this month to complete.

(3) BIWIP contained 40% of conversion costs; therefore, 60% was added this month to complete: $60\% \text{ of } 5,000 = 3,000$.

(4) EIWIP was 30% complete and contained 100% of materials:
 $100\% \text{ of } 8,000 = 8,000$.

(5) EIWIP contained 30% of conversion costs, all added this month:
 $30\% \text{ of } 8,000 = 2,400$.

ALTERNATIVE 2 FOR CALCULATING EQUIVALENT UNITS

	Physical Units	Materials	Labor & Overhead
Completed	14,000 (1)	14,000	14,000
+ Ending Inventory	+ 8,000	+ 8,000 (100%)	+ 2,400 (30%)
Subtotal	22,000	22,000 (2)	16,400 (2)
- Beginning Inventory	- 5,000	- 5,000 (100%)	- 2,000 (40%)
Equivalent Units	17,000	17,000 (3)	14,400 (3)

↑
Started

$$\begin{aligned}
 (1) \text{ Completed} - \text{BI} &= \text{Started and Completed} \\
 14,000 - 5,000 &= 9,000 \\
 \text{OR Completed} &= \text{BI} + \text{Started and Completed} \\
 14,000 &= 5,000 + 9,000
 \end{aligned}$$

(2) Weighted-Average Denominators

(3) FIFO Denominators

Again, both alternatives give the same right answers. Alternative 1 focuses just on the exact numbers produced for this time period. Alternative 2 focuses on the total number completed this time period and then subtracts out the numbers from last time period to arrive at the numbers relevant just for this time period. Is one procedure better than the other? Probably not. One positive feature of Alternative 2 is that, as mentioned above, it does avoid pothole number three since the percentage given of 40 percent can be used (subtracted in alternative 2) instead of having to remember that the 40 percent (for items added evenly) is from work done in the prior time period and that the other 60 percent must be used for completing the work this time period (added in alternative 1). A second positive feature of alternative 2 is that the weighted-average denominators needed for calculating per-unit costs are isolated while calculating equivalent units. On the other hand, a negative feature of Alternative 2 is that units both started and completed are not isolated in the calculation of equivalent units, but are needed later when

completing the problem when calculating the value of units transferred out under the FIFO alternative. The important point here, though, is not to determine the better method, but to be sure to present both methods to graduate level managerial/cost accounting students since the textbook will likely have only one of the two methods and some of the students will probably have had the other method in a prior accounting course. Exposure to both methods will allow students with prior exposure to only the method that is not shown in the textbook the opportunity to see why the way presented in the textbook is not inaccurate, even though it differs from the way they were originally taught. Additionally, even if all students in a class had prior exposure only to the method shown in their current textbook, seeing both methods will alert students to possibilities they may encounter later on when they are in the workforce working with clients.

COMPLETION OF THE PROBLEM

While the main focus of the paper is on the two alternatives for calculating equivalent units of production, completion of the problem does allow the pluses and minuses of each method as they relate to the rest of the problem to emerge. Accordingly, the remaining steps to completing the problem are as follows: Using the FIFO method, prepare schedules for Per-Unit Costs, the Cost of Units Transferred Out (including the journal entry), and the value of Ending Inventory Work-In-Process. Next, repeat the calculations using the Weighted-Average method.

FIFO CALCULATIONS

Step 1 FIFO Per-Unit Costs:

Materials: \$51,000 / 17,000 units = \$3.00

Conversion Costs: \$28,800 / 14,400 units = \$2.00

Step 2 Transferred to Finished Goods:

5,000 Units Beginning Inventory : 100% Materials	\$ 20,500	
40% Conversion Costs	6,460	
To Complete: Materials	-0-	
Conv. Costs (60%) (5,000) (\$2.00).....	6,000	
9,000 Units Started and Completed =		
9,000 (\$3.00 + \$2.00)	<u>45,000</u>	
	<u>\$77,960</u>	

Journal Entry	Finished Goods	77,960	
	Work-In-Process		77,960

Step 3 Ending Inventory WIP:

Materials: 8,000 units x 100% complete x \$3.00 = \$24,000
 Conv. Costs: 8,000 units x 30% complete x \$2.00 = 4,800
\$28,800

WEIGHTED-AVERAGE CALCULATIONS

Step 1 Weighted-Average Per-Unit Costs:

Materials: $[\$51,000 + \$20,500] / 22,000 \text{ units} = \underline{\$3.25}$

Conversion Costs: $[\$28,800 + \$6,460] / 16,400 \text{ units} = \underline{\$2.15}$

Step 2 Transferred to Finished Goods:

5,000 Units	Beginning Inventory	
<u>9,000</u> Units	Started and Completed	
14,000 Units	Completed ($\$3.25 + \2.15)	<u>\$75,600</u>

Journal Entry			
	Finished Goods	75,600	
	Work-In-Process		75,600

Step 3 Ending Inventory WIP:

Materials:	8,000 units x 100% complete x \$3.25 =	\$26,000
Conv. Costs:	8,000 units x 30% complete x \$2.15 =	<u>5,160</u>
		<u>\$31,160</u>

SUMMARY AND CONCLUSIONS

This paper presented two alternative procedures for calculating equivalent units of production. The primary focus of the paper is to ensure that a student with prior exposure to one of the procedures does not feel perplexed if he or she encounters only the other procedure in the textbook. Exposure to both methods at the graduate managerial/cost accounting level allows students to assess the plusses and minuses of each alternative for themselves and then allows them to choose the better method from their individual perspectives.

TEACHING IN WEB 2.0 ENVIRONMENT: TRIALS, TRIBULATIONS, AND TRIUMPHS

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INTRODUCTION

What is all this madness with Social Networking and Collective Intelligence? It seems like everywhere you look there is new application on the internet that allows you to share every minute detail of your life and work with others. As educators, some of us have embraced these technologies in our classrooms and have tried to capitalize on the fact that the new generation of college students think of these tools as an extension of traditional communication media.

This paper provides an insight into how these technologies are utilized in teaching and their impact on student learning. After a full year of integrating these techniques in classroom, this author has reached the conclusion that not all aspects of Web 2.0 technology are effective as pedagogical tools. In this paper, the author shares his experience and provides a list on how to most effectively utilize such tools, what pitfalls to avoid, and how to prepare students for a course that utilizes such methodologies.

As was mentioned in the previous study the main challenges is how and to what extent should we incorporate the internet tools and applications into our courses. This is primarily because of the wide range of Web 2.0 features that are available such as RSS feed, Wiki, Podcast, Twitter, Blogs, You Tube and alike. In addition, it is extremely difficult to know which tool would more effective in creating and delivering course material an in getting actively engaged.

Many new faculty members have fully embraced such tools and are very comfortable with technology. However, when they are asked whether or not such tools enhance student learning, the answer is not very clear. This is partially attributed to the fact that new generation of college professors, similar to the new generation of student, do not think of these as new tools but merely as a variation of the existing tools. As for the more seasoned faculty, the history, memory, and sheer perspective sometimes get in the way of trying new things. You can call it being old school or out of touch but when you have tried almost all pedagogical tools available, you can easily recognize what methods are effective in teaching and learning and what ones are just gimmick.

Well, you can call me one of the brave ones because starting in summer term of 2009, I started using a multitude of Web 2.0 tools in my Information Systems course. Some of the preliminary results were reported at the last SE INFORMS conference. Now, after a full year of implementation and experimentation, I have a much better understanding of how to best utilize these tools. Just to provide some background, I selected my IS course for experiment for three

primary reasons. The first reason is that this course seemed to be a great fit to the subject matter as the process and the product are one of the same. In other words, if the ultimate learning objective is for students to be able to apply information systems and applications to solve business problems, how students learn about using such tools in a part of learning objective as well. The second reason is that I have been teaching this subject since 1982 and have tried almost all teaching and learning enhancement tools imaginable. This would be just another tool that may or may not be as they say “a keeper”. Finally, I felt that in an Information Systems course of all courses students expect to see the latest technology utilized and I did not want to disappoint them. Following provides some explanations of how the course material and delivery techniques were modified to incorporate Web 2.0 tools such as RSS feeds, Wikis, Blogs, YouTube Videos, and Virtual Teams.

Experiment Design

To enhance this course, several internet-based tools were combined with the Blackboard’s course management software capabilities. The set up took into account several factors including:

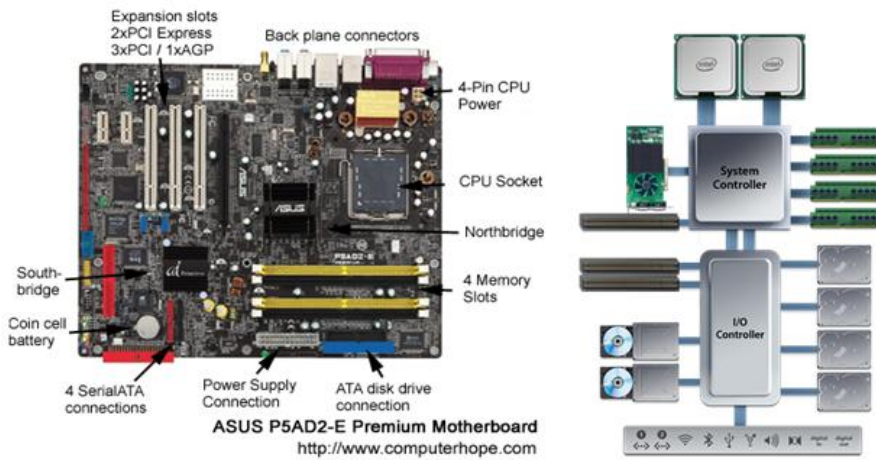
- Course Content
- Communications Methods
- Collaboration
- Evaluation and Outcomes Assessment
- IT Access and Support

Course Content

Trials: The original intention was to design the course content as to eliminate the textbook for the entire or at least part of the course. The idea was to set up the course so that students can generate and develop the course material, the reason being that textbooks can be outdated quickly, particularly in an Information Systems courses. . To accomplish this, a series of Wiki topics were created for the content dealing with IS Concept. Each Wiki contained several images, web links and/or videos and a brief description of the topic. The following is an example of one of these wikis.

Examine the following images of a Motherboard and Bus System and explain the function of one of the following processing components:

1. Motherboard
2. CPU (ALU, Control Unit, Registers)
3. RAM
4. Expansion Slots & Cards
5. Power Supply
6. Bus System
7. Ports
8. I/O Controller
9. System Clock
10. Chipset
11. CMOS



As a part their assignments, students were asked to provide additional information about the topic by adding to the wiki's content through comments. A specific timeframe was given to the students during which students were to provide comments. The system kept track of who has contributed and when.

Tribulations: To encourage students to participate, wikis were assigned a grade based on the number of and quality of contributions. To ensure that students did not receive credit after the deadline, a copy of each wiki was saved after deadline was expired. Also, students were encouraged to read all the contribution made to the topic since part of each of the five quizzes was on the content of wikis. Unfortunately, not all students participated to each wiki and the quality gradually dropped over the semester. Another problem was that since the information contributed by students were not in uniform format and sometimes contradictory, students became confused as what was factual and/or important to know. Subsequently, quiz questions were changed to cover only the material that was discussed in class.

Triumphs: One of the content areas that seemed to be effective was the application portion of the course in which RSS feed was incorporated to provide up-to-date content. This portion of the course dealt with hands-on microcomputer applications and my existing set of lecture notes were converted into format and was made available to students. In addition to the regular content, the

notes contain a series of links that will be interwoven into the document and will point the student to the appropriate websites and/or RSS feeds. The following shows an example for portion one of these documents with embedded link.

Chapter 2 - Intermediate Topics in Spreadsheets

	A	B
7		
8		
9	Christmas Date:	12/25/2009
10	Today:	6/14/2009
11		
12	Days Between Now and Christmas:	194

To gain a better understanding of Date Functions go to "Learn More..." link for this section.

[Learn More...](#)

Lookup Functions

When working with long lists such as rate tables or situations where you need to look up a value in a table, you can use a handy set of functions called **LOOKUP** functions. This function allows you to look up a specific value appearing in any column of a table based on the range of an index number or text that is placed in first column of the table. There are two type variations of LookUp function; vertical lookup or `Vlookup()` and Horizontal lookup or `Hlookup()`. Vertical lookup is used for tables where values for different variables are arranged in columns while horizontal lookup is used for rare occasions when variables are arranged in rows. Since most tables are in column format we will limit this section to explanation of `Vlookup()`.

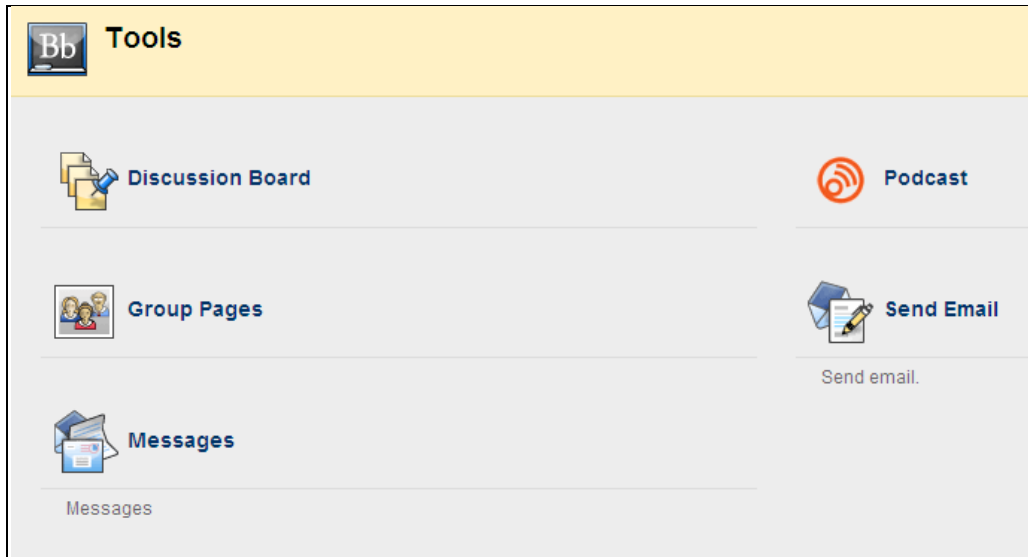
The general form for this function is

= VLOOKUP (Index Value, Lookup Table, Column #)

These documents were available on Blackboard and the intent is to provide additional copies available on other internet-based sources such as Google Reader. For this to take place, all students will be required to create an account on Google in order to have access to all Google tools.

Communication Methods

Trials: Several Blackboard tools were use to communicate with students and for students to communicate with each other. The objective here was to keep them actively engaged in the course. These tools included BlackBoard's Group Pages and Discussion Board. In Addition, the original intent to provide several short lecture audio recordings that can be Podcasted and downloaded to any cell phone or MP3 player. I also maintain a FaceBook page and Twitter account but did not incorporate them into this course. The following image shows BlackBoard's communication tools that were utilized in the course.



Tribulations: Students did not like the discussion board as they deemed it to be somewhat antiquated, however, they used the Group Page feature. The podcast recording never took place as I could not find an easy set up to record and convert them into proper format. I have not tried communication via Facebook or Twitter.

Triumphs: One element that worked quite well was the Group Pages. Students were required to maintain a Group Blog and Group Page feature of the Blackboard seemed to be a good tool. The primary advantage was that it was a more controlled environment for both students and instructor. In addition, this made it easier to remove the blogs from the course Blackboard all at once rather than one team Or one student at a time.

Collaboration

Trials: In addition to contributing to wikis, students were placed in teams for two collaborative projects. First project was for each group to maintain a team Blog on a subject of their choosing relating to the impact of Information Technology. Each group was asked to provide information about the particular topic including images, video and audio files. The image in the following page shows a portion of one of the team's blog.

At the end of the course, the blog information was consolidated into a research paper and an a team presentation. The idea here was to allow other teams to view and comment on other teams' blogs.

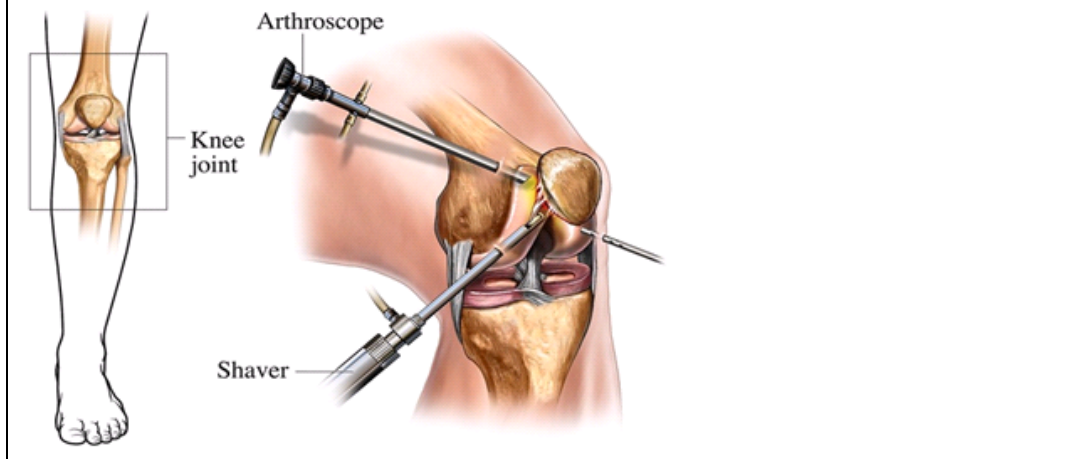
Impact of Technology on Surgery ([permalink](#)) -[edithistorydelete](#)

Created on Friday, 07/10/2009 1:45 PM by [Gregory Cooper](#)

Updated on Wednesday, 07/15/2009 5:23 PM by [Gregory Cooper](#)

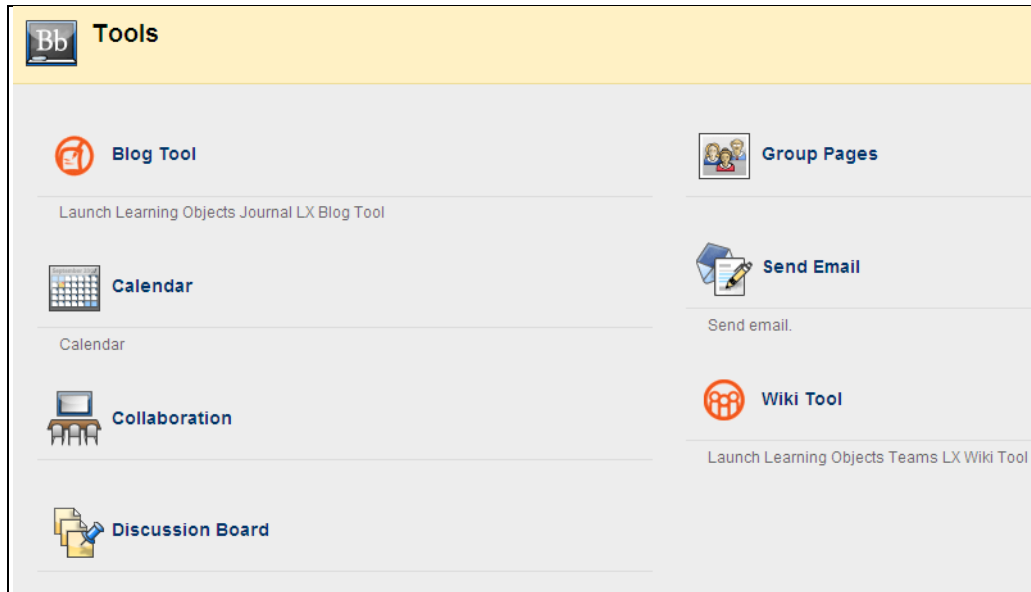
Arthroscopic Surgery

During my senior year of high school I tore my anterior cruciate ligament (ACL) in my knee playing basketball. This injury requires a complex surgery in which the ligament is reconstructed. Many years ago, to fix this injury the surgeons had to cut apart the entire knee to be able to see inside the joint. This left massive scars and lead to many possible complications. Today, after having my surgery a few years ago, I only have one small incision scar and two port hole scars to show for it. Due to technological advances, ACL reconstruction can be done through arthroscopic surgery. Arthroscopic surgery is a minimally invasive surgical procedure in which an examination and sometimes treatment of damage of the interior of a joint is performed using an arthroscope, a type of endoscope that is inserted into the joint through a small incision. This allows the surgeons to see inside the joint as displayed on a video monitor, and make the necessary medical procedures to the ligament. This procedure allows for a lot quicker recovery time and leaves less room for errors or complications. After my surgery I was off crutches in a matter of a few weeks and no complications arose.



The course was designed to make collaborative efforts easier for students and create a new paradigm for learning.

In addition to Blog and Presentation assignments there are two group projects in which students were required to work in teams. Teams were encouraged to use Group Pages feature as a mean for exchanging files as they work on these projects. The original intention was to use other real-time collaboration tools such as Blackboard's Collaboration Session or free online programs such as Google's Knol and Orkut. Following image shows some of the collaborations tools that were available to students.



Tribulations: As usual, not everything works out as I envisioned it. The collaborative work in groups suffered from the usual social loafing as one or two conscientious students ended up doing most of the work for their teams. It was also evident that not everyone had gone to Group Pages to add to team blog. Except for a few instances, quality of writing in the final papers was less than satisfactory. I imagine that some students felt that since they are including images and videos in their blogs, they would not need to do much writing. This was somewhat disappointing since we encourage writing in all of our courses

Triumphs: Oral team presentations seemed to be a bit better than the written research reports. Students were very comfortable with the presentation software and technology. This could be due to the fact that I placed a lot of emphasis on clarity in presentations and smooth transition from one presenter to other.

Evaluation and Outcomes Assessment

Trials: I tried to break up assignments in a way that individual components for each student would be graded separately. Wikis were graded for each student based on the number and quality of contributions. Blogs (research paper) were graded as a team while final presentations were graded both as a team and as an individual. Quizzes related to wikis were administered using Blackboard's Test Manager and were graded on individual basis.

Tribulations: As you can imagine this part of the course proved to be the most challenging. It is always difficult to grade team-based projects, but what made it even more difficult is assessing the true contribution of each individual to the team effort. Some students claimed that they conveyed their thought to teammates and that is why they do not have any blog entries. Another

difficult task was trying to quantify students' contribution to Wiki pages and/or Blogs. This required a tremendous amount of time and fact-checking. The grading for these ended up being a little more lenient than originally intended.

I also compared grades for quizzes with those of the previous year's and noticed that they were 7% lower than last year's quiz grades.

Triumphs: Grades for oral presentations were 3% higher than last year's grades while the overall course GPA was 5% higher than last year. However, this comparison is highly unscientific since many other factors could have contributed to grade fluctuation. As far as measuring students learning outcomes, more data must become available.

IT Access and Support

Trials: Since this IS course has always been taught in a computer lab, IT access and resources have always been important. The use of Blackboard course management software was essential. The hands-on nature of the course is also an important feature of the course.

Tribulations: Contributing to the course content using the Wiki Tool was something new to the student and some did not feel comfortable with the somewhat cumbersome Blackboards tools.

Triumphs: Students like the fact that they can also access all course material through multiple online sources at any time. The institution provided a very effective IT infrastructure for doing this and has encouraged faculty to utilize new technologies in the classroom.

Lessons Learned

1. Students seemed to have an easy time embracing new methods and technologies since they are from a digital generation
2. Students learn a bit more about Web 2.0 environment but I don't believe it enhanced their comprehension or retention of the subject.
3. Collaboration among students were at the same level or even a lower than the traditional group work.
4. The time commitment was very high at the beginning but gradually improved over the three semester period.
5. You can give students new tools and more incentives but you cannot make them write.
6. Adding more assignment to the course does not make the course better.
7. New technologies cannot replace good teaching.

What I Would Do Differently

1. Clearly define expectations for Wikis, Blogs & Teamwork.
2. Cut back on the number of Wiki topics as the amount of material generated has sometimes unmanageable.
3. Create situations that forces students to collaborate on projects.
4. Find a better software to do this.

A SURVEY OF STUDENT ATTITUDES ON PLAGIARISM IN PROGRAMMING COURSES

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ABSTRACT

In order to explore student attitudes regarding plagiarism on programming assignments, a survey instrument was designed and administered to students in programming courses at Georgia Southern University. Students were informed through class discussion as to what constitutes academic dishonesty on a graded assignment. The students then completed a retrospective pre-test/post-test study to provide their views regarding behaviors related to academic dishonesty at the time of assignment as compared to before taking the course. The study was designed to provide insight into perceptions on academic dishonesty, especially as it relates to programming courses and to determine if the class discussion on behaviors that constituted academic dishonesty changes student perceptions on the topic.

INTRODUCTION

Student plagiarism in academic institutions is a problem in many disciplines and has been widely studied [1-2]. There has been a considerable amount of work investigating the use of technology to cheat [1, 3], but little that has studied cheating on assignments where the end product is an electronic file. The authors have only identified one article thus far [4] that investigates whether students have different perceptions of cheating on traditional assignments versus IT related assignments.

We have chosen to address this issue by looking at students' perceptions about plagiarism in programming classes. This type of cheating is especially prevalent; however, much of the research attention has focused on tools for detecting plagiarized code [5-6]. Cheating in programming assignments is problematic because students can get help electronically from online resources in the digital age. Academic dishonesty issues specific to programming assignments can be extended to any type of assignments where the end product is an electronic file.

We also wish to investigate whether faculty can influence students' perceptions regarding academic misconduct. There is some research that has investigated this topic. One study finds that faculty can positively influence student perceptions of cheating by employing more safeguards against academic dishonesty [7]. It also indicates that student engagement in academic dishonesty is most influenced by whether they believe their peers are engaging in academic dishonesty. Another study finds that cheating is contagious among students; that is, peer cheating influences individual cheating behavior [8]. These studies suggest that if students perceive that cheating behavior is common and tolerated, they will be more likely to engage in such behavior themselves.

The two goals for this line of research are to:

1. determine if faculty can influence student perceptions about plagiarism through education about unethical behaviors, and
2. investigate whether students apply the same standards of acceptability for different types of assignments - that is, assignments where the product is a program versus assignments where the product is an essay or a math problem.

To accomplish the two goals, a survey was conducted on student perceptions of the acceptability of a number of behaviors when working on graded, individual assignments for a class. The behaviors included in the survey are based upon the following categories previously identified in the literature [7, 9-10]:

- seeking help from approved sources,
- unauthorized collaboration,
- copying portions of others' work, and
- copying all of others' work.

The types of assignments included in the survey are:

- essay assignments,
- mathematical assignments, and
- programming assignments.

The focus of this paper is to address the first goal listed: to determine if faculty can influence student perceptions of plagiarism through education.

The approach in this study is to use a retrospective pre-test/post-test design in which students provide their view of the behaviors before enrolling in our classes and again after class discussions of ethical and unethical behaviors relating to plagiarism. Similar retrospective pre-test/post-test study designs have been successfully used in academic settings to evaluate the success of educational programs [11-13].

METHODOLOGY

The primary purpose of this study is to determine if education about academic dishonesty policies related to programming can change student perceptions. To this end, a survey instrument was designed and administered to students in programming courses in the College of Information Technology at Georgia Southern University. The survey was a retrospective pre-test/post-test instrument in that students were given a single survey that asked them about their perceptions prior to taking the course as compared to their current perceptions at the end of the course, after class discussion about academic dishonesty.

TABLE 1: SURVEY ITEMS RELATED TO A GRADED PROGRAMMING ASSIGNMENT

How acceptable are the following behaviors?

1. Asking the professor for help on the program.
2. Asking a university provided tutor for help on the program.
3. Reviewing similar programs in your textbook for ideas on how to write your program.
4. Discussing ideas about the program with a fellow student but implementing the ideas independently.

5. Discussing ideas about the program on an Internet news group, social networking site or blog.
6. Working together on the program with a fellow student and submitting similar programs.
7. Copying a few lines of another student's program while adding a significant portion of your own work.
8. Copying a few lines of the program from the Internet or a textbook while adding a significant portion of your own work.
9. Making minor changes to a program you had previously written for another class and submitting it for this class.
10. Posting the assignment on an Internet news group, social networking site or blog and asking someone to write the program for you.
11. Hiring someone or asking a tutor to write the program for you.
12. Copying another student's program, making minor changes, and submitting it as your own.

The items in the survey were created by examining current literature to develop a set of behaviors related to academic dishonesty that applied to graded class assignments [7, 10, 14]. Table 1 provides the list of questions included in the survey instrument. The respondents were asked to indicate (on a Likert scale of *1=Very Acceptable Behavior* to *5=Very Unacceptable Behavior*) how acceptable they felt the behaviors were on a graded programming assignment at two points in time: (1) prior to enrolling in the programming course they were in and (2) after class discussion about academic dishonesty. In addition, several demographic questions were added to the survey to gather information about the respondents.

The survey was administered to students in four different undergraduate programming courses. Table 2 provides an overview of these courses. The survey was administered in class and was anonymous in that there was no identifying information on the survey. There were 114 respondents. All but one response was complete enough to use for analysis (n=113).

TABLE 2: COURSES INCLUDED IN STUDY

Course	Description	Number of Respondents
CSCI 1236 – Introduction to Java Programming	A first course in the Java programming language targeted to Information Technology (IT) and Information Systems (IS) majors. Students are mostly freshmen.	26
CSCI 1301 – Programming Principles I	A first course in the Java programming language targeted to Computer Science (CS) majors. Students should have taken a class in another programming language such as <i>Introduction to Basic Programming</i> before taking this class. Students are mostly freshmen.	16
IT 1430 – Web Page Development	A course in XHTML, CSS and JavaScript for IT students as well as several other majors across campus that require the course for their program. IT students are typically freshmen, while the other majors are usually seniors.	14
CISM 2230 – Advanced Java	A second course in the Java programming language that is almost exclusively IT and IS majors at the sophomore level.	57

DATA ANALYSIS

Demographics of Respondents

The students that responded to the survey were mostly from computing majors offered within the College of Information Technology and the College of Business Administration. The breakdown by major within these two colleges is as follows: Information Technology (46.0%), Information Systems (23%), and Computer Sciences (17.7%). The remainder of the respondents were from the College of Liberal Arts and Social Sciences (7.1%), College of Science and Technology (3.5%), or undeclared or left their major blank (2.7%). Females accounted for 20.3% of the respondents, males 71.7% and the remainder did not identify their gender. Ninety-one percent (91%) of the respondents were age 25 or younger. Forty-eight point six percent (48.6%) of the respondents identified themselves as having a GPA of 3.0 or above. The breakdown of respondents by course can be found in Table 2.

Results

To determine if discussions about plagiarism changed student perceptions as to what is considered acceptable behavior, a paired t-test was conducted for each of the behaviors listed in Table 1. The research hypothesis was that for each behavior that could be considered unethical (behaviors 6 through 12) students would perceive that behavior as more unacceptable after discussing what constitutes plagiarism in a programming course. Each pair of data consists of (1) the perception of the behavior (on a 5-point Likert scale) before taking the course and (2) the perception currently. The results of the t-tests are provided in Table 3.

TABLE 3: PAIRED T-TEST RESULTS

Survey Question from Table 1	t-statistic	p-value (one-tailed test)
1	2.306	0.011**
2	0.729	0.234
3	2.720	0.004**
4	-0.288	0.387
5	0.000	0.500
6	-1.530	0.064*
7	0.000	0.500
8	0.000	0.500
9	-0.555	0.290
10	-2.144	0.017**
11	-2.277	0.012**
12	-1.000	0.160

*Significant at 10%, **Significant at 5%

Survey questions 1, 3, 6, 10 and 11 are statistically significant, indicating a change in perception by students. Questions 1 and 3 are about behaviors that relate to getting help from a professor or textbook. As the t-statistic is positive, students perceived that these behaviors were more acceptable after the class discussion about ethical versus unethical behaviors. Question 6 relates to collaboration on assignments. As the t-statistic is negative, students perceive that collaboration on programming assignments is more unacceptable after taking the course. Questions 10 and 11 are related to having another person do the assignment for you (through posting on the Internet or hiring a person). As the t-statistic is negative for these behaviors, students perceive these behaviors as more unacceptable as well.

Another interesting result is the t-statistic of zero for questions 5, 7 and 8. Survey question 5 relates to discussing ideas on the Internet while 7 and 8 are related to copying small portions of the program while producing most of the work yourself. These statistics were not zero because there was no difference in perceptions. The test-statistic of zero is due to the fact that students were mixed in their changes in perceptions. Some students felt these behaviors were more acceptable, while other felt they were more unacceptable. If the absolute value of the change in perception is used, the p-values for each of the test statistics corresponding to questions 5, 7 and 8 are less than 1%, indicating a strong statistical significance and underlying shift in perception.

DISCUSSION AND CONCLUSION

This study investigated student perceptions of the acceptability of behaviors related to academic dishonesty on programming assignments. A retrospective pre-test/post-test survey was administered to 114 students in four different programming courses at the authors' institution. The survey assessed student perceptions of these behaviors before enrolling in the course and after participating in faculty-led class discussions of what does and does not constitute academic dishonesty in such courses. The goal of this study was to determine whether these discussions could change student perceptions about plagiarism particularly as it pertains to programming assignments.

Our results suggest that faculty-led class discussions can indeed alter student perceptions as to what is considered acceptable (or unacceptable) behavior. Specifically, following class discussions, students in our survey perceived asking the professor for help and/or relying on textbook examples for help in writing programs to be more acceptable than they perceived them to be prior to enrolling in the course. On the flip side, students perceived working together with another student, posting the assignment on the Internet and asking someone to write the program for you, and hiring someone to write a program for you to be less acceptable following class discussions than they did prior to enrolling in the course.

While these results are encouraging, the authors were surprised to find that student perceptions of the acceptability of copying another student's program, in whole or in part (as reflected by Questions 7, 8 and 12), did not change at a statistically significant level. This is of greatest concern with respect to Question 12 (copying another student's program, making minor changes, and submitting it as your own). Given that faculty stressed the unacceptability of copying the work of others, the most likely explanation we can offer for this result is that students apply a different standard of acceptability for programs than they do for other types of assignments. Investigating this question is the second goal of our research and will be addressed in our next round of data collection.

Our findings for Questions 7 and 8 (which deal with copying a few lines of code from another student or Internet site), as well as for Question 5 (discussing the program online), are also perplexing. As previously stated, the test-statistic for these items was zero, indicating that changes in student perceptions were mixed - some students felt these behaviors were more acceptable while other felt they were more unacceptable. One possible explanation for these findings is the effect of peer influence. Students who originally thought this was not acceptable may have changed their minds if/when they discovered that others were engaging in the behavior (and vice versa). Another possible explanation is that there may have been subtle differences in the viewpoints expressed by faculty (or the student interpretations of those viewpoints) as to the acceptable limits of "working together" on an assignment. Some faculty may have clearly stated that no discussion with another student is acceptable, while others may have stated that discussing ideas about the program with others is OK provided all work is completed independently. Further investigation is needed to answer these questions.

FURTHER RESEARCH

Several avenues for future research have been identified. First, as originally planned, the authors will investigate whether there are differences in student perceptions of academic dishonesty between programming assignments and other types of assignments. It is our hypothesis that students apply different standards of acceptability of cheating behaviors to programming assignments than they do to essays, math problems, and other work. Second, we plan to extend the analysis to other types of computer-based, electronically submitted assignments (such as Excel spreadsheets, Access databases, etc.), perhaps focusing on required literacy/tools courses taken by business students. We hope to expand the work done by Molnar et al. by comparing students' perceptions across Third, we intend to compare our findings across students in various colleges and degree programs to see if there are any differences in perception based upon academic discipline. Finally, we will conduct a factor analysis to determine if the twelve questions used in our survey group into the categories previously identified by Jian, Sandnes, et al. [10].

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PRESENTATION PROPOSAL

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Removing Barriers for Students and Faculty in Study Abroad

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Globalization has had a profound impact on higher education. Although it is a well known fact, that participation in international studies programs broadens a student's understanding of our global environment, actually getting students to participate in such programs is often the biggest challenge. Many institutions of higher education offer a variety of international studies programs, ranging from short programs with durations of less than one month to the full academic year. Topics offered during the programs are often multidisciplinary which should appeal to a wide range of majors. Given the generic nature of the program offerings, why do so few students choose to participate in these programs? Part of the reason could be the actual dissemination of program information to the student body. In a recent survey of an average southwestern institution, students were asked to about their knowledge of international study opportunities available and results were startling. Even though multiple channels of program information were used to disseminate information, fewer than one half of the students surveyed were aware that such programs existed.

Angelo State University has expanded their study abroad program and support services for students and faculty by broadening the scope of their programs and by removing financial barriers, through the international studies scholarships and programmatic barriers through the passport office and on-line application process. The outcome of the new initiatives has tripled the number of students participating in the study abroad programs within two years with a retention rate of 96.8% of all participating students remaining in the institution after their return. Faculty mentoring programs, merit reward and language training provided to the faculty at no cost has greatly improved faculty involvement and interest in international education and study abroad.

Objectives of the sessions are as follows:

- Assess the various types of study abroad programs currently in use by higher education institutions
- Determine what obstacles institutions face in recruiting students to participate in study abroad programs
- Provide suggestions and strategies for improving their internationalization efforts.

In this session, it is recommended that participants bring examples of their promotional efforts for a discussion of what works or does not work at their respective campuses. It is hoped that a sharing of this information will help participating institutions recruit students to the international studies programs. Workshop presenters will also share results of the survey and provide copies of their most successful recruitment efforts.

Tomlin Bio

Dr. Sharynn Tomlin, Professor of Management serves on the faculty of the Department of Management & Marketing at Angelo State University in San Angelo, Texas. She received her BBA and MBA from Angelo State University and her doctorate in organizational theory and policy from the University of North Texas.

At Angelo State University, she is the Director of the Center for International Studies, which received the 2010 Heiskell Award for Innovation in Study Abroad from the Institute for International Education. She also chairs the International Education Committee, International Business Symposium and the American Electric Power Distinguished Visiting Scholar Committee. Dr. Tomlin is the Nathan and Sylvia Donsky Endowed Distinguished Chair of Management and was selected by the ASU Alumni Association as the 2004 Distinguished Faculty Member of the year. Dr. Tomlin has also served as the President of the Faculty Senate and elected member of the Tenure and Promotion Committee. She has been recognized by the Delta Sigma Pi International Fraternity as an outstanding faculty member. For the past 15 years, she has directed study abroad programs to Germany, England, Costa Rica, China, Italy and Scotland. Dr. Tomlin has organized numerous seminars and workshops dealing with international issues and serves on the Texas Consortium for Study Abroad and the Texas International Education Consortium. Additionally, she was responsible for the curriculum development of the new international business degree, and advises all international business majors.

Dr. Tomlin has been an invited guest speaker regarding international curriculum development and teaching, and has presented papers in numerous international conferences. Dr. Tomlin is also past chairperson of the International Trade Committee at the San Angelo Chamber of Commerce, participated in trade missions

to Mexico with local businesses, past chairperson of the International Trade Office Advisory Board and served as the President of the Board of Governors for the North American Association for Small Business International Trade Educators. She has received two grants from the U. S. Department of Education, Title VIB – Business and International Education Program and serves as a grant proposal reviewer and evaluator. Additionally, Dr. Tomlin serves on the Board of Directors for the West Texas Lighthouse for the Blind.

MAKING YOUR ASSESSMENT PROCESS GO VIRAL

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ABSTRACT

This paper describes a process that explicitly incorporates input from Business Advisory Council members into student learning outcomes assessment. The process is based on a practical assessment model using competencies suggested in the Global Benchmarking Initiative applied using a linked cascading information matrix protocol. Business Advisory Council input is obtained on a regular basis and linked to the development and/or verification of identified program competencies. The inclusion of this information permits the council to observe how their ideas directly impact curriculum and program activity development and assessment. Assuming that the linked cascading information matrices are constructed to track the development of a student, the assessment data also can be employed during academic advising to evaluate a student's progress in the program and compare it to that of other students at similar stages of development.

Development of Competencies

The process begins with the selection of competencies that link the body of business knowledge to the wishes of the business community. This is often a tricky task. The business community often wants technical and practical skills with general lack of appreciation regarding the process to development of these skills in conjunction with the knowledge required to prepare students for a career and not merely a job. A process that proves beneficial to accomplishment of this task commences with a simple brainstorming session involving members of a College's Business Advisory Council. A facilitator elicits input from the council members, listing skills the council feels are desirable for students to exhibit upon graduation. Next, the suggestions are categorized into individual groups. These groups are compared to published information, evaluated by faculty members and ultimately used to develop a set of competencies. By using a matrix linking the competencies with the grouped suggestions, the council is shown how their suggestions are addressed by the competencies. This same process can be repeated on a regular basis to verify and update the list of competencies. Although most often a faculty trusts their curriculum provides a set of courses that collectively supports and enhances each student's competencies in the selected areas, there remains a need to involve first hand practical business needs and to verify the level to which the students have improved their skills in these key areas.

Initially, based on discussion with our Business Advisory Council and a review of the existing literature regarding required business skills, the Dauch College of Business and Economics at Ashland University decided to adopt the set of student learning outcomes associated with the critical competencies identified by ACBSP. As part of the Global Benchmarking Initiative, rubrics were developed and tested in the following seven areas:

1. Communications
2. Critical Thinking
3. Business Knowledge and Technical Skills
4. Leadership/Teamwork Skills
5. Ethics
6. Analytical/Quantitative Skills
7. International and Global Perspective

These rubrics can be used for formative and summative periodic assessment of student learning outcomes within a college or program. In addition, they can be used to collect representative data across multiple institutions for benchmarking purposes, using the Global Benchmarking Initiative (GBI) database system developed by ACBSP and hosted by LiveText, Inc.

Although the College’s faculty and administrators believed that this set of competencies were appropriate, we decided to validate the competencies with input from our Business Advisory Council (BAC). A brainstorming session was held as part of a regularly scheduled meeting of the BAC. During the session, BAC members were asked to provide answers to the question “What competencies do our graduates need?” A faculty facilitator obtained input from each BAC member using a standard brainstorming process, while a second faculty facilitator recorded and displayed the responses. Forty-four responses were recorded and subsequently grouped into eleven categories of critical skills. The eleven categories were mapped against the seven College competencies, and the results were presented to the BAC members later in the meeting, giving the members an opportunity to review the competencies and verify their applicability. Figure 1 presents the results of the Business Advisory Council session in matrix form, showing the mapping of the eleven critical skills to the competencies identified by the college.

Once a set of College-level competencies has been selected and validated, assessments of student learning outcomes related to these competencies must be embedded in required courses so that all students are assessed as part of their curriculum requirements. Table 1 shows where assessments are placed in the curriculum.

Table 1: Embedded Assessments

Content Area (Competency)	Core Course	Class Level	Assessment Evidence
1. Communications	MIS 221 Information Technology	FR/SO	MS Word paper assignment
2. Critical Thinking	ECON 232/233 Micro/Macro	FR/SO	Essay on exam
3. Business Knowledge	various in each major (see below)	various	various methods (see below)
4. Leadership/Teamwork	MGT 240 Intro. to Management	FR/SO	case analysis
5. Ethics	MGT 401 Business Law I	JR/SR	case analysis
6. Analytical/Quantitative	MGT 319 Operations Management	SO/JR	case analysis
7. International/Global	MKT 233 Principles of Marketing	FR/SO	case analysis

The third competency area, business knowledge, includes content from all functional areas of business. In addition, the faculty in each program major must determine a set of specific competencies relevant to students majoring in that area, and then link those competencies to the College competencies using the same matrix mapping described earlier. A sample mapping for the Marketing program major is shown in Figure 2.

Once this is completed, the final step is linking student learning outcomes from each course and/or activity to the program competencies. Figure 3 shows such a mapping for the MKT233 Principles of Marketing course. During this step, faculty will find this to be an important tool for program development and curriculum review. Implementing a curriculum mapping process is a natural compliment to this approach.

The summative assessment is applied in the capstone course in the form of a case analysis that will be evaluated using rubrics designed by ACSBP and is part of a Global Benchmarking program that will enable comparison of business programs worldwide. Total summative assessment will include this information, review of the student's internship experience, and results from the ETS Major Field exam. The progress of each student is monitored using these marker assessments and the cumulative outcome of the process combined with the final summative assessment from the final program assessment. This process is most effective when administered via an assessment management assistance program. Without this type of electronic organizer the paperwork would be overwhelming and prohibitive.

The final step in this process is the application of formative assessments during the advising process. For example, as a Marketing student progresses thru the program they will complete formative assessments during each class. Using the assessment data management program an advisor can monitor the students progress and compare to other students at the same point in the program. The advisor can highlight strong and weak performance as it relates to the identified competencies of the program and remedial actions can be taken to assist the student in development of these required competencies. In addition, to the student benefit the faculty can periodically review these data and revise the program components on a real-time basis.

Naturally, this is a continual process that is a closed loop. It begins with the inclusion of advisors and other identifiers of stakeholder requirements, permits faculty to translate the body of knowledge through coordinated programs to the students, and offers a real-time review process for students and program. The cascading matrix plan allows this to be accomplished with maximum visibility and inclusion of all interested stakeholders.

Figure 1: Linking Business Advisory Council Input to College Competencies

		COBE Competencies						
		Communications	Critical Thinking	Business Knowledge and Technical Skills	Leadership and Teamwork Skills	Ethics	Analytical and Quantitative Skills	International and Global Perspective
Categories from Business Advisory Council Brainstorming	Critical Skills	Applicable	Applicable	Applicable	Applicable	Applicable	Applicable	Applicable
	Communications (3)	X		X	X			
	Leadership skills (4)			X	X			
	Ethics (2)			X		X		
	Understanding job demands (3)		X	X				
	Experiential learning (5)	X		X	X		X	
	Functional business integration and networking (5)		X	X				
	Analytical and problem solving skills (4)		X	X			X	
	Critical thinking (5)		X	X	X			X
	Global exposure (other cultures) (5)			X				X
	Lifelong learning and adaptability (4)		X	X				
Sales skills & entrepreneurial mindset (4)	X		X	X		X		

Figure 2: Linking Program Competencies to College Competencies

	COBE Competencies						
	Communications	Critical Thinking	Business Knowledge and Technical Skills	Leadership and Teamwork Skills	Ethics	Analytical and Quantitative Skills	International and Global Perspective
Marketing	Applicable	Applicable	Applicable	Applicable	Applicable	Applicable	Applicable
Perform appropriate market research, define market segments, and describe critical market characteristics and trends.	X	X	X			X	
Develop operational product plans.	X		X				
Develop product placement criteria and distribution channel alternatives.			X			X	X
Develop pricing practices based on appropriate quantitative pricing models.			X			X	
Develop product promotion and sales plans.	X	X	X		X	X	
Prepare, implement, and manage an integrated market plan that meets the domestic and/or global requirements of the business.	X	X	X	X	X	X	X

Figure 3: Linking Individual Course Outcomes to Program Outcomes

		Upon completion of a Marketing Major a student will:					
		Perform appropriate market research, define market segments, and describe critical market characteristics and trends.	Develop operational product plans.	Develop product placement criteria and distribution channel alternatives.	Develop pricing practices based on appropriate quantitative pricing models.	Develop product promotion and sales plan.	Prepare, implement, and manage an integrated market plan that meets the domestic and/or global requirements of the business.
Student Learning Objectives	Bus 233 - Principles of Marketing	Applicable	Applicable	Applicable	Applicable	Applicable	Applicable
	1. Actively exhibit how marketing has evolved over the last 3 centuries.	X	X	X	X	X	
	2. Demonstrate an understanding of how the dynamics of uncontrollable factors must be considered when dealing with the controllable aspects of marketing.	X		X		X	
	3. Demonstrate how product success can be monitored, using various business models, in a global environment.	X	X	X	X	X	
	4. Create a marketing research model, using current technology.	X					
	5. Demonstrate how all product categories (physical, service, etc.) must complement one another.		X	X		X	
	6. Show how pricing concerns, cost analysis, and consumer perception of price interrelate.		X	X	X		

EXPLORING THE USE OF RUBRICS FOR STUDENT SELF-ASSESSMENT IN A QUANTITATIVE COURSE

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ABSTRACT

Formative evaluation is used to improve student learning and performance. Student self-assessment, using performance criteria provided by the instructor, is one method of providing formative evaluation. A rubric is a set of guidelines for performance evaluation. This paper presents a research design for using rubrics to provide criteria for student self-assessment of Excel assignments in an undergraduate Operations Management course. A process for developing rubrics is described, and a sample rubric is presented. A questionnaire is developed to survey students about the usefulness of the rubrics, student motivations to use them, and reasons why some students might not use them.

INTRODUCTION

Summative evaluation is the process of assigning a score or grade to students' work for the purpose of grading, program review, or accreditation review. In contrast, *formative evaluation* is the process of providing feedback to students for the purpose of helping them learn more and improve their work (Andrade and Du, 2007; Ozogul and Sullivan, 2009). A *rubric* is a set of guidelines for assessing student performance, including expectations and evaluation criteria (Popham, 1997). Rubrics have been used for both formative and summative evaluation (Anglin et al., 2008; Andrade, 2007; Nitko, 2004; Stevens and Levi, 2005).

Formative evaluation can be provided through instructor feedback, peer evaluation by other students, or self-assessment by students (Ozogul and Sullivan, 2009). A substantial body of research shows that when students are given clear criteria for assessing their work and have adequate time to revise their work, self-assessment increases student learning; this research has been summarized by Andrade and Valtcheva (2009). A well-designed rubric is an effective tool for specifying criteria for self-assessment (Andrade, 2007; Andrade and Du, 2007; Stevens and Levi, 2005).

This paper presents a research design and data collection instruments for an exploratory study of the use of rubrics for student self-assessment of Excel assignments in an undergraduate Operations Management course. Two research instruments, a sample rubric and a questionnaire, will be presented. The questionnaire is designed to collect student feedback about the perceived usefulness of the rubrics and the reasons why some students may use them, while others might not.

REVIEW OF LITERATURE

Student Self-Assessment

Andrade and Du (2007) define *student self-assessment* as "a process of formative evaluation during which students reflect on and evaluate the quality of their work and their learning, judge the degree to which they reflect explicitly stated goals or criteria, identify strengths and weaknesses in their work, and revise accordingly (p. 160)." Andrade and Du (2007) describe the three steps in an effective self-assessment

process. First, the professor shares performance expectations with students; this is usually done by presenting a rubric, model assignment, or examples of previous student work. Second, students prepare a draft of the assignment and compare their work with performance expectations. Third, students use the results of the comparison to improve their work before submitting it to the professor for feedback or for a grade. This process is called *criteria-referenced self-assessment* (Andrade and Du, 2007).

Andrade and Du (2007) used criteria-referenced self-assessment in a study of student attitudes toward self-assessment. Students in an educational psychology course were required to use rubrics to assess their own work before submitting it for a grade. In focus group interviews at the end of the course, students stated that self-assessment helped them focus on the important elements of assignments, improve their skill in evaluating their own work, and learn more (Andrade and Du, 2007).

The question of whether the results of student self-assessment should be included in the computation of course grades has been raised in the literature. Counting self-assessment results as part of the course grade raises student concerns about fairness and encourages students to overstate the quality of their work (Andrade, 2007). Andrade (2007) also mentions anecdotal evidence that faculty have similar concerns.

Rubrics

Rubrics have a variety of uses. In the classroom, rubrics can be used to communicate expectations to students, allow students to assess their own work before submitting it, give students feedback before an assignment is due, grade student work, help students understand their grades, and facilitate consistent grading in courses with multiple sections and instructors (Anglin et al., 2008; Andrade, 2005; Nitko, 2004; Stevens and Levi, 2005). For teachers, using a rubric reduces the time required to give students feedback about their strengths and weaknesses (Anglin et al., 2008; Andrade, 2005; Stevens and Levi, 2005). Stevens and Levi (2005) state that rubrics are especially helpful to students whose background for a particular course is weak. At the department and college levels, rubrics are used for program review and accreditation review (Palomba and Banta, 1999; Suskie, 2004).

Both general-purpose and task-specific rubrics can be found in the literature. General-purpose rubrics provide consistent performance standards across assignments within a course section. If appropriate measures to ensure inter-rater reliability have been taken, general-purpose rubrics can also provide consistent standards in a multi-section course, or across all courses within a department (Palomba and Banta, 1999; Stevens and Levi, 2005). Using a general-purpose rubric also eliminates the need to develop multiple rubrics; this is a major advantage for complex types of rubrics. On the other hand, special-purpose rubrics include more specific performance expectations, which may make it easier for students to understand the expectations. Nitko (2004) states that special-purpose rubrics often provide more accurate assessment data for program review and accreditation review.

Educators have used a variety of rubrics, including checklist rubrics, holistic rubrics, single-level analytic rubrics, and multi-level analytic rubrics. Information about the different types of rubrics and methods for constructing them can be found in the books by Nitko (2004), Stevens and Levi (2005), and Suskie (2004).

The simplest type of rubric is a *checklist rubric*, which is a list of criteria for evaluating student work. On each criterion, the student either meets the criterion or fails to do so. Checklist rubrics are useful tools for student self-assessment and for providing instructor feedback to students before an assignment is due. Some students cannot check the quality of their own work, but they can check for the presence of required elements (Ozogul and Sullivan, 2009). Students can also check aspects of their work that are easy to evaluate, such as chart formatting. Unlike a grading system, a checklist rubric does not provide an

overall measure of student performance. Consequently, these rubrics are not recommended for grading, program review, or accreditation review (Lund, 2006).

Stevens and Levi (2005) presented a general process for developing rubrics. This process has been adapted to checklist rubrics, as shown below:

1. Define the learning objectives of the assignment
2. Develop the task or assignment.
3. List the criteria that will be included in the rubric. For a checklist rubric, it is helpful to start with the elements of the task. Additional criteria may be based on grading standards that have been used in the past, and on mistakes that students often make.
4. Arrange the criteria in a logical order, and group them appropriately.
5. Test the rubric against actual or hypothetical student work. Will the criteria be clear to students? Do the criteria provide an adequate basis for student self-assessment, and for providing feedback to students?
6. After you have used the rubric with students, evaluate the rubric and make changes if necessary.

The rubric presented in this paper was developed using the first five steps of this process. After the rubric has been tested with students, it will be evaluated, and any needed changes will be made.

RESEARCH DESIGN

Procedure

As stated earlier, this study will be an exploratory analysis of the use of rubrics for criteria-based self-assessment of Excel assignments in an undergraduate operations management course. The primary research objective is to help students, particularly those who have difficulty with calculations or Excel, improve their performance. Three research questions will be examined:

1. Will the use of rubrics help students improve their performance?
2. What motivations do students have for using rubrics?
3. What factors might discourage some students from using rubrics?

Special-purpose checklist rubrics will be used in this study. This type of rubric was selected because it provides detailed performance expectations to students; in addition, checklist rubrics are easy to develop. Rubrics will be developed for three Excel assignments: Pareto analysis, statistical process control, and linear programming; each rubric will be distributed with the related assignment. Students will be encouraged to use the rubrics for self-assessment before submitting their work to the teacher for formative evaluation (if they choose) or grading. After each assignment has been graded and returned to students, they will be asked to complete a brief, anonymous questionnaire about the rubric for that assignment. The questionnaire will be used to collect data about the research questions and get student feedback about how the rubrics could be improved.

Evaluation Questionnaire

The questionnaire is divided into three parts. In Part I, students who used a particular rubric are asked to rate its usefulness on several criteria. In Part II, those same students are asked to make suggestions for improving the rubric. In Part III, students who did not use the rubric are asked to identify their primary reason for not using it; several possible reasons are listed.

Figure 1: Rubric Evaluation Questionnaire

The purpose of this questionnaire is to evaluate and improve the assignment rubrics used in this course.

- If you turned in Assignment 1 and used the rubric, please complete Part 1 and Part 2.
- If you turned in Assignment 1 and did not use the rubric, please complete Part 3.
- If you did not turn in Assignment 1, please do not complete this questionnaire.

Part 1 - In each row of the table, please check the response that matches your opinion.

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
The rubric was clear and easy to use.					
The rubric helped me understand the assignment.					
The rubric helped me evaluate and improve my work.					
My work would have been just as good without the rubric.					
The rubric helped me learn more from doing the assignment.					
The rubric helped me complete the assignment more quickly.					
The rubric helped me make a better grade.					
Using the rubric took too much time.					
The benefits of the rubric were worth the time and effort required to use it.					
It is likely that I will use the rubrics for other assignments in this course.					

Part 2 - How could the rubric be improved? Please be as specific as you can.

Part 3 – Please check the primary reason that you did not use the rubric.

- _____ The rubric was hard to understand.
- _____ I did not need the rubric.
- _____ I did not have time to use the rubric.
- _____ I did not think that the rubric would be helpful.
- _____ I expected to get the grade I wanted without using the rubric.
- _____ I did not know about the rubric.
- _____ I forgot about the rubric.
- _____ Other (please specify)

Part I of the questionnaire recognizes the objectives of both faculty and students. The author hopes that using the rubric will help students understand the assignment, evaluate their work, improve their work, and learn more from the assignment. Students may share these objectives, but some may also consider the costs, in time and effort, of using the rubric and the benefits of using it. Those students will probably be more willing to use the rubric if they believe that the benefits will be worth the time and effort required to use it, that using the rubric will help them earn a better grade, or that using the rubric will help them get the assignment done more quickly. Students may also be more likely to use the rubric if they think that it is clear and easy to use. Part III of the questionnaire assumes that students are less likely to use the rubric if they believe that it is hard to understand or that they will not benefit from using it. Part III also recognizes that some students might not notice the rubric or might forget about it.

A RUBRIC FOR PARETO ANALYSIS IN EXCEL

The Assignment

Pareto analysis, which is used to set priorities for quality improvement, is a standard topic in Operations Management courses. The student is given a frequency table for various categories of product defects, customer complaints, or other incidents related to quality performance. In the simplest form of Pareto analysis, the student is required to sort the incidents in descending order, compute the percentage of incidents in each category, and produce a bar chart of the results. This analysis gives a graphical answer to the question, "Which quality problem should be eliminated first?" A more advanced version of Pareto analysis includes the computation of cumulative percentages and the addition of a cumulative percentage line to the chart (Heizer and Render, 2011). Since the height of the longest bar and the cumulative percentage line usually differ by an order of magnitude, a secondary vertical axis must be added to the chart for the cumulative percentage line. The resulting chart answers both "Which quality problem should be eliminated first?", and "Which quality problems must be eliminated to reduce defects by 80%?", or another appropriate percentage. Cumulative sums are also used in ABC inventory analysis and in cumulative sum charts for statistical process control of attributes.

The assignment presented here has been used in a junior-level course in Operations Management. Most students had acquired a basic knowledge of Excel, including some familiarity with charts, in prerequisite courses. The assignment included the following learning objectives:

1. Complete a Pareto analysis, including cumulative sums, in Excel.
2. Use Excel to perform a custom sort.
3. Compute cumulative sums in Excel.
4. Add a secondary vertical axis to a chart.
5. Develop a professionally formatted chart.
6. Interpret the results of the analysis.

Learning objectives 2, 3, and 4 relate to Excel capabilities that most of the author's students have not previously been taught. In Excel 2007, the custom sort is necessary because the data is not sorted on the first column of the data table. Objective 5 adds a professional development component to the assignment. This straightforward assignment provides a good review of basic Excel formulas and charts before students tackle more challenging assignments later in the course.

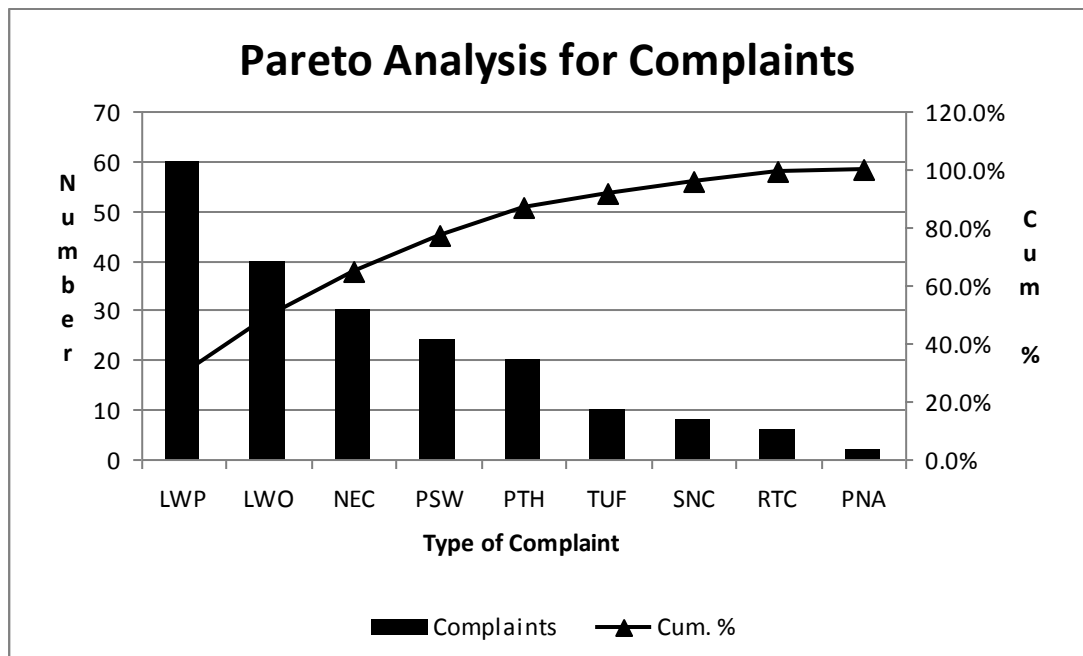
Instruction in Pareto analysis begins with an explanation of the required calculations and an interpretation of the results. Then instructions for doing the assignment tasks in Excel are distributed. The computer projection system in the classroom is used to demonstrate a custom sort. Next, the assignment, which is based on a different problem from the one in the instructions, is distributed, and any questions from students are answered. The data for the assignment consists of an unsorted list of incident categories, with frequencies for each category. Figure 2 shows a completed Pareto analysis table. The second column lists abbreviations for the categories; those abbreviations will be used as data labels in the chart.

Figure 3 is an example of an acceptable chart. The data is plotted correctly. The chart has a chart title, titles for each axis, a legend, and data labels. The chart is easy to read.

Figure 2: Completed Pareto Analysis Table

Complaint	Data Labels	Number of Complaints	% of Complaints	Cumulative % of Complaints
Long wait to get pizza	LWP	60	30.0%	30.0%
Long wait to take order	LWO	40	20.0%	50.0%
Not enough cheese on pizza	NEC	30	15.0%	65.0%
Poor service from waitress	PSW	24	12.0%	77.0%
Prices too high	PTH	20	10.0%	87.0%
Tough pizza crust	TUF	10	5.0%	92.0%
Staff not courteous	SNC	8	4.0%	96.0%
Restaurant too cold	RTC	6	3.0%	99.0%
Pepperoni not available	PNA	2	1.0%	100.0%
TOTAL		200	100.0%	

Figure 3: An Acceptable Pareto Chart



Developing the Rubric

Since this assignment had been used in the past, the first step in developing the rubric was to list the grading criteria for the assignment. The list was developed in three sections: (1) analysis, which includes sorting the data and doing the required computations, (2) the chart, and (3) interpretation. The grading criteria for the analysis were based on the required steps; these criteria were listed in the order in which they should be done. The grading criteria for the chart were based on the required elements and

formatting, including titles and axis scales. Since students could do the formatting steps in various sequences, the grading criteria for the chart were arranged in a logical order. The interpretation category includes only one criterion, which requires an explanation of how management could use the results to make decisions. If a description of the expected interpretation were included in the rubric, some of the interpretation would actually be done for the students.

After the criteria had been developed, the types of mistakes that students had made in the past were considered.

- In the analysis, the most common mistakes are not sorting the data, sorting it in ascending order, and mistakes in computing cumulative sums. Some students may be able to detect sorting errors if the rubric includes the standard for sorting. In the author's experience, it is less likely that students who make errors in computing cumulative sums can find their own mistakes. Therefore, the rubric includes only a requirement to compute cumulative sums.
- In the past, a few students have used a calculator to complete the analysis and then typed the answers into Excel. The rubric includes a requirement to do the calculations in Excel.
- In the chart, the most common errors are omitting the secondary vertical axis and omitting one or more titles. The rubric requires students to include these elements.

The next step was to check the rubric for completeness and clarity. The finished rubric is shown in Figure 4. Grading criteria are listed on the left. Students use the check boxes to indicate whether their work meets or does not meet particular criteria.

Figure 4: Checklist Rubric for the Pareto Analysis Assignment

	Meets	Does Not Meet
ANALYSIS		
The categories are sorted by number of incidents (defects or complaints) from largest to smallest.		
The total number of incidents has been computed.		
The percentage of incidents in each category has been computed. Each answer is formatted as a percentage.		
The cumulative percentage has been computed for each category. Each answer is formatted as a percentage.		
There are Excel formulas in the spreadsheet for all calculations.		
CHART		
The number of complaints in each category is plotted as a bar chart. The bars are sorted from highest to lowest.		
The cumulative percentage is plotted as a line.		
The chart has a legend which shows the meaning of each data series.		
The data table includes a column of data labels that are used in the chart. The data labels are short enough to make the chart easy to read.		
The scale for the bar chart is shown on the left vertical (primary) axis.		
The scale for the line is shown on the right vertical (secondary) axis.		
The chart has a title that shows what the chart is about.		
There are titles for the horizontal axis, the left vertical axis, and the right variable axis. Each title identifies the quantity plotted on that axis.		
The entire chart is easy to read.		
INTERPRETATION OF RESULTS		
The spreadsheet includes an interpretation of the results, explaining how management would use the results to make decisions.		

For a quantitative assignment, a checklist rubric closely follows the requirements of the assignment. This type of rubric can usually be developed in two hours or less. The author has used similar rubrics for simple quantitative cases, which are set in a business context and usually have more data than typical textbook problems. In that type of case, students are required to explain the implications of the computational results, but the explanation is usually a straightforward application of material that has been taught. More complex rubrics are needed for cases that require extensive business analysis, such as making recommendations for implementing a Six Sigma program in a particular company.

CONCLUSIONS

The use of special-purpose checklist rubrics for student self-assessment may be a promising approach for improving student performance in quantitative courses; a research design for an exploratory analysis of this approach has been presented. This paper includes a questionnaire that will be used to survey students about the usefulness of the rubrics, student motivations to use them, and reasons why some students might not use them. A process for developing checklist rubrics has been described, and a sample rubric has been presented.

This study will have several limitations. First, it will be based on student perceptions of how the rubrics affected performance and learning. Second, students at the author's university have prior experience with rubrics, which are used in several required writing courses. These students may be more willing to use rubrics in a quantitative course than students who are not familiar with rubrics. Third, the setting for this study is a university that has moderately selective admissions policies and attracts students from diverse educational backgrounds. While there are probably a large number of institutions with similar admissions policies, there are also universities with different policies. Students at universities with less selective admissions policies might have a greater need for task-specific rubrics; students at institutions with highly selective admissions policies may not need rubrics for simple computational assignments.

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- WORKSHOP -

MAINTENANCE OF ACCREDITATION: TELLING YOUR AOL STORY

Coordinators: Randall Bandura and Paul Lyons, both of the College of Business, Frostburg State University, University System of Maryland.

This workshop reflects our efforts to “close the loop” as a college of business prepares its final work for maintenance of accreditation in the five-year, AACSB accreditation cycle.

In this workshop we plan to:

- (1) explain & examine the requirements of a college of business for preparing for maintenance of accreditation [AACSB], in-general;
- (2) examine the expectations of AACSB for reporting of progress with assurance of learning [AOL] in the life of the college;
- (3) Provide some examples of how a college of business might construct its story, of how to reflect upon its efforts, successes, and needs per AOL;
- (4) present to session attendees some suggestions, content, information collections, etc., that could help a college tell its AOL story and demonstrate continuous improvement; and
- (5) invite session attendees to reflect upon and offer information that characterizes their knowledge and experience in the involvement of faculty in processes preceding AACSB visits.

Workshop intended for: The session is intended for college of business faculty and academic administrators, although the primary focus is on the needs and interests of faculty. Given that practically all faculty and academic administrators, regardless of college or program, are participants in various forms of assessment of student performance, the workshop may assist all.

What we want to do in this workshop is help attendees attain a clear view of what is needed to be sure that the college “story” of its AOL efforts is well expressed and supported. There is no explicit template, no formula available for guidance on how to prepare for the five-year review with regard to assurance of learning. We are learning, together, how to make the case that our college is making good on its AOL goals and how we are improving the instructional experience for our students.

IMPACT OF THE ASSURANCE OF LEARNING STANDARD ON STUDENTS' LEARNING

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ABSTRACT

This paper explores whether the Assurance of Learning Standard of the AACSB International has had any positive impact on the students' learning of business students. Presumably, when the focus of business schools is shifted towards the students' actual learning measured by direct methods of assessment one should be expecting improvement in students' learning. This study investigated the changes in the performance of business students in the ETS Major Field Test in Business at the national level for periods before and after the adoption of the Assurance of Learning Standard by the AACSB. The results suggest possible improvements in the students' learning.

INTRODUCTION

In 2003, the Association to Advance Collegiate Schools of Business (AACSB) International revised its standards for accreditation by shifting the focus of the standards to the actual learning outcomes of business programs measured by direct methods. Specifically, the AACSB's new standard -- "Assurance of Learning" -- requires business schools to produce evidence of learning in their courses and programs. Under the Assurance of Learning standard, business schools have to set learning goals for what knowledge and skills they want their students to learn, and then demonstrate that the students have meet the specified learning outcomes. The new accreditation standards leave it up to each institution to decide what those learning outcomes should be and how they should be measured.

For compliance with the "Assurance of Learning" standard, the AACSB has suggested two categories of assessment methods -- direct and indirect -- as follows:

Direct Methods:

Selection,
Course-embedded measurement, and
Stand-alone testing

Indirect Methods:

Surveying alumni
Surveying employers
Surveying graduating students

The AACSB has clearly stated that the indirect methods cannot replace the direct methods for assessment of student performance. By themselves, surveys produce weak evidence of learning. As a result, a special interest has been demonstrated in the application and implementation of the *direct methods* of assurance of learning.

RESEARCH OBJECTIVE

The purpose of this study was to investigate whether the Assurance of Learning Standard has had any positive impact on the business students' learning. Presumably, when the focus of business schools is shifted towards the students' actual learning measured by direct methods of assessment one should be expecting improvement in students' learning.

RESEARCH METHOD

The ETS Major Field Test in Business is one of the popular *direct methods* for the assessment of business students' learning. It is a standardized test that assesses the business students' mastery of concepts, principles, and understanding obtained in the core business courses. The subject areas included in the test are: Accounting, Economics, Management, Quantitative Business Analysis, Finance, Marketing, Legal and Social Environment, Information Systems, and International Issues. The ETS Major Field test is a two-hour, entirely multiple-choice exam. The scores are reported on a scale of 120 to 200. The ETS reports contain data on the individual students as well as overall performance of the students' of each school along with national means for comparative purposes. This study investigated the changes in the business students' performance in the ETS Major Field Test in Business for periods before and after the adoption of the AACSB's Assurance of Learning Standard.

FINDINGS

Table below displays the national mean for each subject area for period 2003-2006 and 2006-2009. The highest increase is in the area of Finance (53%) followed by International Issues (22%).

Subject Area	2003-2006	2006-2009	Percentage of Increase
	Mean	Mean	
Accounting	44.1	49.8	13%
Economics	42.5	47.8	12%
Management	56.8	54.5	-4%
Quantitative Business Analysis	56.1	46.1	-18%
Finance	35.9	55.0	53%
Marketing	46.6	51.9	11%
Legal & Social Environment	49.6	45.9	-7%
Information Systems		57.7	
International Issues	44.2	54.1	22%
Overall Mean Score	152.2	153.1	1%

CONCLUSION

The findings of the study suggest realization of some improvements in the business students' overall performance in the ETS Major Field Test in Business after the adoption of the Assurance of Learning Standard. In an exchange of emails, the AACSB stated that none of the business schools have lost their accreditation since the passage of the Assurance of Learning Standard. However, the AACSB stated that approximately 20% to 25% of business schools received a sixth year recommendation – that is, some deficiencies were perceived during the review. However, “It is not uncommon for more than one standard to be cited in a report therefore it is difficult to state what percentage of sixth year reviews are solely due to concerns regarding Assurance of Learning.” Overall, it appears that the Assurance of Learning Standard has had a positive impact in business students' learning.

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BUSINESS WEEK
SUPPORTING THE ASSURANCE OF LEARNING PROGRAM

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ABSTRACT

Three pillars of AACSB accreditation are strategic planning, assurance of learning, and faculty qualifications [8]. Schools of business develop strategic plans and assurance of learning programs and build faculty based on mission driven goals. Peer review teams focus on these areas during the formal accreditation visits. This paper focuses on a set of activities that support the assurance of learning program at an AACSB accredited university in the southeast.

INTRODUCTION

AACSB – International, The Association to Advance Collegiate Schools of Business, is the premier accrediting body for schools of business in the world. As of September 2009, 570 member institutions hold AACSB business accreditation, of which 171 have additional specialized accreditation for their accounting programs. In total 33 countries represent the Accreditation Council, and 105 members are from outside the United States.

AACSB accreditation and maintenance of accreditation is based primarily on three areas:

1. Mission-based strategic planning
2. Assurance of Learning
3. Faculty sufficiency

All accredited business programs and those seeking accreditation must develop and be guided by mission-based strategic plans that have been structured using faculty input and that support the strategic mission of the institution as a whole. Accredited business programs must maintain a qualified faculty who is dedicated to the mission of the program. In addition, accredited business programs must develop an Assurance of Learning program (AOL) that helps them manage the curriculum designed to produce highly qualified graduates [1, 8]. A previous paper [3] discussed a survey of South Carolina business school deans designed to determine current Assurance of Learning practices. The number of goals, the range of topics assessed, and the problem areas identified were some of the information discussed in that paper. This paper focuses on a set of activities that support the assurance of learning program at South Carolina State University.

THE ASSURANCE OF LEARNING PROGRAM AT SC STATE UNIVERSITY

South Carolina State University is a comprehensive, 4-year, state supported university in Orangeburg, SC. With over 4,000 students, the university boasts accredited programs in

business, engineering, education, and many other disciplines. The Business Program received maintenance of accreditation by AACSB in April 2010. The Business Program has over 600 students majoring in five areas, accounting, agribusiness, economics, management, and marketing.

Following initial accreditation in 2001, the School of Business faculty of South Carolina State University began work on initiatives to improve the business programs. Development of a formal program to assess the curricula would be important as the university moved toward reaffirmation of accreditation. After numerous phases of development, the Assurance of Learning Program was formally approved by the faculty in 2007. Four learning goals and twelve learning objectives were approved to guide curricular decisions. The learning goals are:

1. Business majors will develop and demonstrate the ability to engage in critical thought processes whereby they are able to skillfully analyze, assess and resolve complex business problem.
2. Business majors will develop and demonstrate leadership skills in their personal and professional lives.
3. Business majors will demonstrate the knowledge of ethical conduct in business and the value of good citizenship.
4. Business majors will be cognizant of the global community in which we live and work.

Assessment of these goals and objectives has helped the Business Program determine areas that need attention. A number of initiatives have been designed to address the identified needs. Writing and critical thinking were among the areas identified in this process as needing special attention. The activities described below were designed to support our efforts to improve student performance in these and other areas of learning.

THE ROLE OF ACTIVE LEARNING IN SUPPORT OF LEARNING GOALS

In recent years, the teacher-centered model has been replaced with the student-centered model. There are numerous successful active learning techniques documented in the literature. These activities include the modified lecture, invited guest speakers, videos, movie clips, peer teaching, debates, and experiential learning projects. Several studies have shown that students prefer strategies promoting active learning to traditional lectures. Other research studies evaluating students' achievement have demonstrated that many strategies promoting active learning are comparable to lectures in promoting the mastery of content but superior to lectures in promoting the developments of students' skills in thinking and writing. Further, some cognitive research has shown that a significant number of individuals have learning styles best served by pedagogical techniques other than lecturing [4]. Many students enter higher education conditioned by their previous educational experiences to be passive recipients of what they are taught. Making space for students to take control of and responsibility for their learning can greatly enhance their ability to learn from experience [6].

Leonard Springer conducted research to specifically determine whether differences in the learning outcome were apparent to faculty representing a variety of disciplines as well as to the students who participated in the course. The results suggest that students who participated in structured active learning perceived a greater ability to connect abstract concepts and real-world applications than students who participated in a relatively traditional instruction program. The positive effect of structured active learning on students' abilities to connect concepts and applications extended to both men and women [7]. The basic theme among all experiential learning models is that learning through applicable experiences, with requisite reflection and synthesis, provides for the best education [2, 5, 6].

At SC State University, the active learning model has been integrated into a long-standing annual celebration – Business Week – to spotlight AOL goals and to provide opportunities for students to demonstrate what they are learning in the classroom.

BUSINESS WEEK 2010

Each year, a committee made up of faculty, staff, and students of the Business Program plans and executes a week of activities related to a specific theme. The 38th Annual Business Week Celebration was held April 5 through April 9, 2010. The theme for Business Week 2010 was, “Making a Difference through Thought Leadership and Citizenship in the Global Community.” This theme was based on the Business Program Learning Goals to ensure that our students excel in critical thinking, communication, citizenship, and knowledge of global business issues. One goal of Business Week each year is to ensure that all students participate in at least one of the activities planned for the week. Some of the activities are integrated into classes to enhance the theory and applications presented in those classes. The programs and activities of Business Week 2010 were planned to reinforce and help students become more aware of and appreciative of the knowledge, skills, and attitudes that make up our learning areas. Opportunities to learn, serve, and develop were planned for each day. These activities were designed to coordinate with the learning goals in order to produce outcomes consistent with the content delivered throughout the business curriculum. Table 1, provided in the Appendix, summarizes the activities, participants, and outcomes described in more detail in the following sections.

MONDAY – OPENING SESSION AND CRITICAL THINKING

Learning Goal 1: Business majors will develop and demonstrate the ability to engage in critical thought processes whereby they are able to skillfully analyze, assess and resolve complex business problem.

The objectives for Business Week 2010 Day 1 included setting the tone for an attitude of service, providing opportunities for demonstrating speaking and critical thinking skills, and continuing to stress the importance of quality writing. For the opening session, four community leaders spoke about how students could make a difference in our community. The Executive Director of the Edisto Habitat for Humanity, the Executive Director of the Samaritan House (a homeless shelter and food and clothing outlet), the Founding Director and Chairman of the Board of the Cooperative Church Ministries of Orangeburg (an outlet for food, clothing, and emergency funding for electricity and other needs), gave the history

and missions of their respective organizations and challenged students to make a difference by getting involved in community activities. The publisher of the local newspaper encouraged students to build their writing skills, indicating that solid writing skills would make a difference in their careers. Improving writing skills is a major part of our leadership learning goal. Some 50 students and faculty members attended this opening session.

Following the opening session, two case competitions, designed to help develop critical thinking skills of students, were concluded. Six teams competed in the Strategic Management Case Competition. The presentations by the seniors in these sections of the capstone class – Business Policy - showed the polish of well prepared soon-to-be graduates. Ninety students attended the Strategic Management Case Competition.

Over 150 freshmen competed in the Introduction to Business Case Competition. Five student teams, winners of competitions in the five sections of Introduction to Business, were asked to identify a project that they could implement to make a difference. A panel of three judges was used to select a winner. The criteria used included the meaningfulness and feasibility of the community service project, the thoroughness of the description of the project and the team's presentation skills. More than forty students attended this session.

The contrast in the presentation skills as well as the depth of analysis was evident in these two case competitions. This contrast gives us evidence of the value added by our curriculum and will give our Assurance of Learning Committee insights into how to continue our focus on critical thinking skills in core courses.

TUESDAY – CITIZENSHIP DAY

Learning Goal 3: Business majors will demonstrate the knowledge of ethical conduct in business and the value of good citizenship

On Citizenship Day, over 100 students and faculty members participated in community outreach projects. Participants collected money for Relay for Life and Habitat for Humanity. Relay for Life has been the Business Program Community Outreach Initiative for three years. Each year students, faculty and staff have raised more than \$2000 for Relay for Life. A raffle netted over \$200 for the American Red Cross. A display from the Minority AIDS Council of Orangeburg showing facts about AIDS and other STDs was set up in the business building lobby to provide information to students. Over \$250 was raised to purchase books that were given to kindergarten students at two local elementary schools and to donate \$100 to the Minority AIDS Council of Orangeburg. Ten students visited Uni-Health Nursing Home and led the residents in games of Bingo and provided a gift basket of treats for the residents.

The closing program for Citizenship Day was directed by a guest professor from the Citadel who brought expertise in volunteerism and disaster relief. She discussed ways students could become more active in community outreach projects and how SC State students could partner with Citadel students to help make a difference, particularly during disaster times. Awareness of opportunities and actual participation in community outreach projects were the main takeaways for this day.

WEDNESDAY – LEADERSHIP AND COMMUNICATION DAY

Learning Goal 2: Business majors will develop and demonstrate leadership skills in their personal and professional lives.

Wednesday was Leadership and Communication Day. The Executive Speaker Series hosted the Administrator in the South Carolina Department of Consumer Affairs whose talk was entitled, “Credit Sense and Debt Management: Keys to Success in Life and Business.” The speaker challenged the students to be leaders and to take charge of their own financial futures. One-hundred and eighty students attended this presentation.

The first annual Writing Competition was completed on Leadership and Communication Day. Each participant submitted an essay on “Making A Difference Through Servant Leadership.” Eighteen students participated in the competition that was supported by a Title III grant. Cash prizes were awarded to the students with the best papers: first place, \$300; second place \$200; and two students tied for third place and each received the \$100. In addition, eight students were awarded honorable mention certificates for excellent writing.

The Writing for Life Workshop was held for students with guest experts encouraging students to work to develop excellent writing skills and providing strategies for improvement. Students were assigned to teams at the beginning of the workshop. Each team was given an excerpt from anonymous papers submitted by students who had participated in an earlier workshop. Each team had fifteen minutes to critique the excerpt. In the open session that followed, a discussion of each paper was led by the workshop presenter. This workshop was also supported by a Title III grant.

The SC State Chapter of Toastmasters International held the Table Topics Contest where eight students responded to the question, “If you could have the ideal career, where do you see yourself ten years from now, and where do you see yourself twenty years from now?” Students demonstrated quick thinking and excellent speaking skills in this competition. No student had the advantage of hearing other students’ speeches before responding to the topic. First, second and third place winners were selected by a panel of judges.

Promoting excellence in communication was a 2009-2010 focus for the Business Program. Building an attitude of concern for developing and demonstrating excellence in communication was supported with the Day 3 activities.

THURSDAY – INTERNATIONAL DAY

Learning Goal 4: Business majors will be cognizant of the global community in which we live and work.

In preparation for International Day, students in two classes, International Business and Export Management, interviewed students and faculty members from countries outside of the United States, collected information about their home countries, and made posters that were displayed in the business building lobby. Over twenty posters showed maps and other information about these countries, as well as pictures of the student or faculty member. Flags from over forty-five countries were displayed in the lobby as well, depicting countries represented in the SC State student body.

At noon, the Business Program hosted the “Taste of the World” buffet. Students enjoyed dishes from some fifteen countries. Samples of cuisine from these countries were supplied by students and faculty.

The closing session for International Day was the International Brain Bowl. Fifteen students divided into five teams competed in a Jeopardy-like contest, showing their knowledge of world history, geography, politics, culture, and current events.

Students gained knowledge of and appreciation for business and culture around the world. As over eighty percent of SC State students hail from South Carolina, this exposure helped to broaden their horizons.

FRIDAY – STUDENT AWARDS DAY

Highlight for the week for some came Friday when over 100 students were honored for academic excellence and for winning competitions during the week. Nine students were inducted into Beta Alpha Psi, the International Honor Fraternity for Financial Information Professionals. Twenty-three students and two faculty members were inducted into Beta Gamma Sigma, the Honor Society for AACSB International. The Honors and Awards Banquet was held on Friday Night where students who had earned a cumulative 3.0 grade point average were recognized. Seniors with the highest grade point average in each major were also singled out for this achievement. Two faculty members were awarded with the Dean’s Distinguished Service Award for outstanding efforts.

CONCLUSION

The planned activities, case competitions, writing and speaking competitions, and the International Brain Bowl gave students opportunities to apply and demonstrate the knowledge and skills acquired in the Business Program Curriculum. The students were engaged and this generated much excitement throughout the week. While Business Week is an annual celebration, the consensus among faculty and students was a need to provide more opportunities through out the year that will challenge students and allow them to practice what they are learning. The Business Week Program not only highlighted the knowledge and skills of our students; but also brought faculty, staff and students together to focus on our learning goals and objectives.

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APPENDIX

Table 1: Business Week Activities and Learning Goals

Business Program Learning Goals	Business Week Activities	Primary Participants	Learning Goal Outcomes (Knowledge , Skills and Attitudes)
Critical Thinking	Business Case Competitions	All freshmen enrolled in Intro to Business Courses and all Seniors enrolled in Business Policy. Student and faculty audience members.	Activities provided opportunities for student to increase critical thinking and communication SKILLS through the preparation and presentation of the cases.
Communications and Leadership	Guest Speakers Essay Writing Competition Toastmaster’s Competition Writing for Life Workshop Honor Society Inductions Honor’s Banquet	Student and faculty audience members. Student volunteers for the essay competition and students with GPAs above 3.0 for the honors inductions and banquet.	Activities provided opportunities for students to develop SKILLS related to written and oral communication and to develop positive ATTITUDES toward community participation and volunteerism.
Global Awareness	International Brain Bowl International Poster Presentations and Flag Display International Food Festival	Students in the required International Business course and an IB elective course; student, faculty and staff volunteers for the Food Festival.	Students were exposed to information that added to KNOWLEDGE of the global community and also promoted positive ATTITUDES toward international diversity.
Citizenship	Student Organization Fund Raising Community Outreach Initiatives Guest Speaker	Student and faculty volunteers and members of student organizations.	Activities focused on promoting positive ATTITUDES toward community involvement and volunteerism and also increased KNOWLEDGE by exposing students to the activities of organizations focused on addressing critical needs in the community.

LEARNING RETENTION RATE AND ACTIVE LEARNING

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ABSTRACT

Learning retention is a problem that many students and instructors face in today's competitive academic arena. Instructors in upper level courses expect students to be equipped with the knowledge and content area pre-requisite classes. Tantamount to success in upper level classes is retention of knowledge from principles courses. Often times, students do not have the recall or the foundation necessary to be successful in upper level classes. Faculty often expect good retention as a matter of course and do little to determine the skills and abilities of their students. This study examined retention rates from a Principles of Financial Accounting, ABUS 225 course as students began the next sequential accounting course, Principles of Managerial Accounting, ABUS 226. Retention rates were determined using a short examination measuring knowledge of general income statement and balance sheet accounts.

INTRODUCTION

Many college courses have prerequisites that must be completed before another course can be attempted. These courses require that knowledge be retained from an earlier course to be successful in the current course. There are several questions that need to be answered if we are concerned with students retaining information. Does successful completion of a course ensure that the concepts presented in the course are retained by students? What is the best teaching method to aid in retention? What can we do to help students retain the content presented? For learning retention to occur there must be receptivity to learning. Students must see how the learning is applied to their studies or work. If there is no willingness to be receptive to learning, any information presented to the student will have a low level of retention. (Jones, 2007)

ACTIVE LEARNING

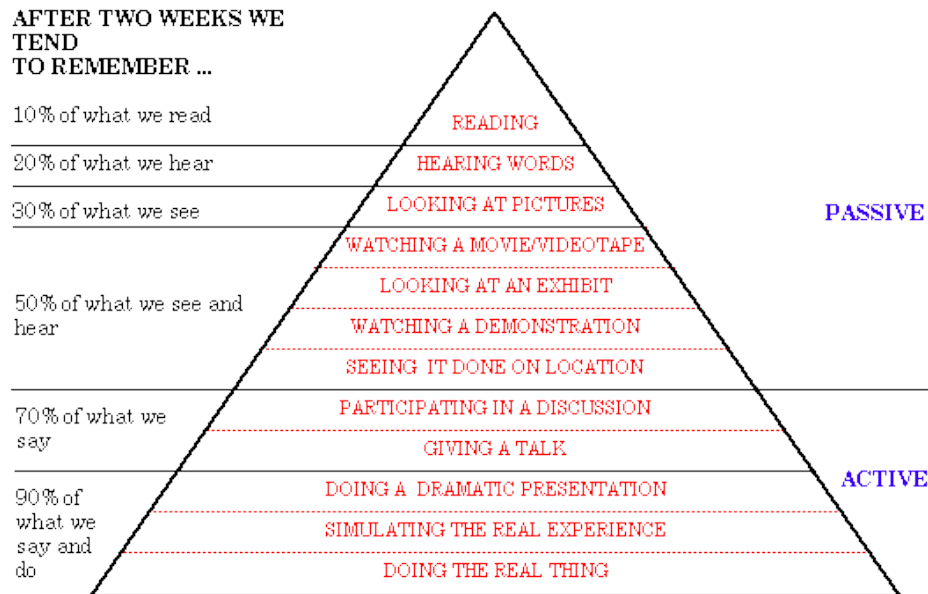
To stimulate and activate learning receptivity and retention, there are methods that can be employed to help students retain concepts and facts that are necessary for future courses. We can engage in learning which is experiential and shared with others. It should be reflective and allow students to see the big picture. It also should allow time for integration and application. (Jones, 2007) This implies that, even with the best teaching methods, students may not retain the level of knowledge necessary to be successful in later courses. The individual student has to be responsible for an attitude of learning for retention to occur. As teachers, we can help them by motivating them and encouraging a positive attitude so retention can occur, but we cannot assure that it will always take place.

Much research has been done on teaching methods (Dale, 1969, Chickering and Gamson, 1987). In many typical classrooms, students are passively engaged in learning. They are listening to the instruction, looking at overheads or slides or reading the text book. Research

shows that passive involvement leads to a limited retention of knowledge by students (Felder and Brent, 1997). Wilbert J. McKeachie phrases it this way. (McKeachie, 1998, 1)

“The best answer to the question, “What is the most effective method of teaching?” is that it depends on the goal, the student, the content, and the teacher. But the next best answer is, “students teaching other students.”

Edgar Dale has also suggested a similar hypothesis. Dale determined that the effectiveness of learning or the learning retention rate is determined by the method of instruction (Dale, 1969).



Adapted from: Edgar Dale *Audio-Visual Methods in Teaching*, Holt, Rinehart and Winston.

The Cone of Learning

McKeachie (McKeachie, 1998) suggests that after two weeks from the initial leaning, we tend to remember 10% of what we read, 20% of what we hear, 30% of what we see, 50% of what we see and hear, 70% of what we say, and 90% of what we say and do.

Research indicates that by re-organizing and adapting the way we present material to students, instructors can create an environment in which knowledge retention is significantly increased (Felder and Brent, 1997). This requires the cooperation and willingness of the student to learn. One of the best teaching methods is active learning. Active learning is defined as “engaging students in doing something besides listening to a lecture and taking notes to help them learn and apply course material. Students may be involved in talking and listening to one another, or writing, reading and reflecting individually.”(Felder and Brent, 1997)

“Active learning is not merely a set of activities, but rather an attitude on the part of both students and faculty that makes learning effective. The objective of Active Learning is to stimulate lifetime habits of thinking to stimulate students to think about HOW as well as WHAT they are learning and to increasingly take responsibility for their own education.” (Hatfield, 1995, 40)

Collaborative learning is a type of active learning that encourages students to interact with one another while learning and applying the course material. It usually involves small groups and posing questions, allowing each group to discuss, and then suggesting possible outcomes to others. To be considered collaborative learning, all members of the group must participate. One or two students cannot do all the work.

There are benefits of active and collaborative learning besides information retention. There is increased interaction between faculty-student and student-student. It usually leads to increased academic achievement and higher-level thinking skills. Other benefits are communication skills, teamwork and motivation to learn.

Active learning works because groups tend to keep on going when one student may get stuck on a problem and give up. Students learn alternative problem-solving strategies and become less fearful of answering questions among themselves and in class. And as McKeachie said, students learn best what they teach. By using active learning methods in class, we can give students the opportunity to become part of a class and learn by doing. (Felder and Brent, 1997)

If we are to increase the retention rate, we must be sure that we create assignments that will require students to become involved in the classroom and in peer-related activities. If we really believe that retention is important, it is imperative that we become an advocate for active learning. This study examines the retention rates from a Principles of Financial Accounting, ABUS 225, to a Principles of Managerial Accounting, ABUS 226. These classes are normally taken in consecutive semesters; however, it is not a requirement. The only prerequisite for Principles for Managerial Accounting is successful completion of Principles of Financial Accounting.

METHOD

At the beginning of Principles of Managerial Accounting students were asked to classify the following sixteen (16) general ledger accounts as either an asset, liability, revenue, expense, or equity: Cash, Notes Payable, Accounts Receivable, Sales, Inventory, Depreciation, Utilities, Salaries, Common Stock, Equipment and Land, Prepaid Expenses, Accounts Payable, Interest Paid, Retained Earnings, Cost of Goods Sold, and Interest Income. They were also asked to select the correct equation for items that appear on an income statement and balance sheet. Students were then asked to write the accounting equation. Other information collected included grade in Principles of Financial Accounting, sex, race, and concentration. The concentrations for students normally in the Principles of Financial and Managerial Accounting classes are accounting, finance, management, and marketing. There is also a core of students from the Fitness Management degree that are required to take the two accounting courses. These students, along with others from across campus, were classified as other concentrations. There were 128 students in the sample. Table 1 shows the percent of correct answers that were recorded for each question by all students responding to the survey.

TABLE 1

Account	% Correct	Account	% Correct
Cash	.97	Prepaid Expenses	.29
Notes Payable	.76	Accounts Payable	.74
Accounts Receivable	.46	Interest Paid	.62
Sales	.79	Retained Earnings	.28
Inventory	.69	Cost of Goods Sold	.38

Depreciation	.54	Interest Income	.65
Utilities	.77	Income Statement	.69
Salaries	.80	Balance Sheet	.62
Common Stock	.59	Accounting Equation	.41
Plant and Equipment	.56	Overall	.61

An analysis of Table 1 shows that students do not understand the equity section of the balance sheet. Only 28% correctly classified retained earnings as an equity account. Most of the students who misclassified retained earnings believed it to be a revenue account. Even though 62% could identify the Balance Sheet Equation, only 41% could write the accounting equation. They did not appear to equate the balance sheet as being the accounting equation. Subjects also showed weaknesses in the classifications of cost of goods sold, accounts receivable and prepaid expenses. Cost of goods sold was often categorized as an income account and accounts receivable as revenue. Even though prepaid expenses were classified correctly by only 29% of the students, we believe that this could be expected from a group with only one principles of accounting class. Cash was readily recognized as an asset by 97% of the students.

TABLE 2

Grades	# of Students	% of Correct Answers
A	50	.69
B	46	.58
C	25	.57
D	6	.48

Table 2 above shows the results of the survey by grades that students earned in the Principles of Financial Accounting class. As expected, the students who earned A's were able to correctly classify 69% of the accounts as compared with 61% for the overall body of respondents. There was no difference in the B and C students. The number of students earning D's was too small to draw any conclusions.

TABLE 3

Concentration		
Accounting	20	.75
Finance	15	.62
Management	43	.60
Marketing	18	.61
Other	31	.56

Accounting majors correctly identified 75% of the accounts as shown in Table 3. There was no perceptible difference in the other majors in the School of Business. We believe this shows that accounting majors were more focused and interested in the course than other concentrations. This should give accounting professors in this first class the incentive to stress the importance of the content of the class, not just for accounting majors, but for all business majors. By stressing the importance of these rudimentary accounting skills as necessary for majors, faculty could perhaps help improve the attention and retention of all students taking these accounting courses.

TABLE 4

Sex		
Male	62	.62
Female	66	.62

Table 4 shows no difference in the retention rate of males and females.

TABLE 5

Race		
African-American	38	.58
Caucasian	90	.64

Table 5 shows the difference in retention by race. A probable explanation of this difference is African-American students are not encouraged to focus on business as a major or other societal factors.

CONCLUSION

Educators that teach upper level classes have a reason to be concerned about the preparedness of their students. Often the most seasoned or tenured professors are given the upper level classes to teach and lower level classes are taught by teaching assistants or adjunct faculty. One way to increase retention in classes would be for professors to monitor the content of lower level classes and verify that content needed for upper classes is properly covered. Learning objectives established by faculty who teach these classes could help assure consistent coverage. Common exams across all sections would force faculty to cover the material consistently. However, presentation of material class does not mean that the students will retain the information. They may learn it for an exam and not retain it for later recall.

Research indicates that active learning gives students a better chance of retaining material. (Hatfield, 1995) From experience, we have determined it is very hard to engage classes in active learning. Several obstacles to active learning are class size, time allotted for class, and amount of material that must be covered in a class. Another obstacle, and perhaps the greatest, is the resistance in a change in teaching methods by faculty that have been teaching for several years. Increasing the use of active learning takes much more preparation by faculty than lecturing on a topic that they have been teaching for years.

In spite of the obstacles to using active learning, there are ways to motivate students to embrace this technique. Creating study groups with various skill levels could give the good students the opportunity to teach others. Study groups also give the less gifted student more exposure to the material, more time to ask questions, and more opportunity to learn from others.

Technology can also provide ways for students to engage in active learning. They can be put into groups to prepare presentations, solve problems, and interact without ever having to physically meet in a classroom. Technology also gives educators another way to provide students with learning experiences. Most textbooks have packages that allow educators to give

quizzes online. Assigning on-line chapter quizzes encourages the student to read the chapters and be better prepared for class. An impediment to online quizzes is the fear from educators that students will collaborate in doing the assignments. However, if students are told that it is alright to use the book and to work together in completing the assignment as long as the group has no “freeloaders”, the goal of getting the students to do the work is accomplished.

Content retention from one course to the next has been an issue in higher learning for some time. The assumption has been that students retain most of the information from successfully completed courses. This study suggests that there are underlying factors that affect retention. Faculty are encouraged to determine retention rates in order to best meet the needs of their students. Small retention rates may point to a systemic problem within a school or major course of study. Further research is needed to identify process that will help increase retention and thereby increase the success rate of our students.

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Implementing a Degree Completion Program
at Coastal Carolina University

46th Annual Meeting of Southeastern Chapter of INFORMS
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Track 1: Undergraduate Student Research

Undergraduate Student Paper Competition

Implementing a Degree Completion Program at Coastal Carolina University

Abstract

This research project was done to determine what is important to students in deciding whether to transfer or not transfer to CCU in order to complete a Bachelors degree. Data were collected from those who: obtained an Associates Degree from a community college, transferred from another four year school of higher education, or returning to complete an undergraduate degree after previously dropping out. Other objectives were to understand the requirements to enter CCU as a transfer student, and to understand what other majors people are interested in that are not offered at CCU. Qualitative Individual Depth Interviews followed by Quantitative Self-Administered Questionnaires to measure how important 11 transfer policies are and how satisfied students are with those policies. After reviewing the current research, it can be concluded that a degree completion program would benefit Coastal Carolina University and its community members. The program should be designed around weekend and evening classes, easy transfer rules, what jobs in the area are in high demand, offer more internship opportunities and incentives, and allow for flexible time schedules of classes as well as expanding the online class availability.

Introduction

Two trends have been occurring at Coastal Carolina University: Reductions in State of Carolina funding and increasing enrollments. One source of new students that has not been fully tapped is transfer and returning students who represent about 5% of the new students. Consequently a new Department of Admissions Bridge Program was developed to encourage Horry Georgetown Technical College AA graduates to come to Coastal Carolina University to continue their education was developed and a web-based Transfer and Articulation Center was developed by the Commission on Higher Education (www.sctrac.org) to support the transfer of credits from other centers of higher education to Coastal Carolina University, as well as other Four Year South Carolina Universities. At the request of Dr. David Evans, Associate Provost and Director of the Bridge Programs, a research study was completed in the Spring 2010 semester by the Marketing Research class in the Wall College of Business. The objectives were to: determine what is important to students in deciding whether to transfer or not transfer to CCU in order to complete a bachelors degree including students who have obtained an, Associates Degree from a community college, transferred from another four year school of higher education, or who are returning to complete an undergraduate degree after previously dropping out, and to understand what other majors people are interested in that are not offered at CCU.

Method

As part of active learning (Anderson, 1997), the purpose of the team research project in the Marketing Research course was to determine what is important to students in deciding to transfer or not transfer to CCU to complete a bachelors degree after 1) obtaining an Associates Degree

from a community college, transferring from another four year school of higher education, or 3) returning to complete an undergraduate degree after dropping out before graduation. In short, we want to understand the key drivers to Bachelors degree completion at CCU and the barriers to entering CCU as a transfer or former student. The team research project involved two phases: Qualitative followed by Quantitative.

Qualitative

In-depth Interviews (IDIs) were done with equal quota snowball samples of males (30) and females (30) in three segments:

1. AA Degree Recipients (n = 20)
2. Transfer Students (n = 20)
3. Returning Students (n = 20)

Qualitative Interviews Concerning Attitudes

In these individual depth interviews (IDIs), concerning student attitudes were done by asking the following questions:

- 1.) Why did you transfer to CCU?
- 2.) Why should there be a tuition repayment program?
- 3.) Should there be an entrance exam and or placement testing? Why?
- 4.) Why do you feel there should be a cap on the number of students admitted to CCU?
- 5.) What other majors should be offered at CCU and why?
- 6.) If you could design an 'IDEAL' Degree Completion Program, what would it look like?

The interview will follow the discussion guide developed in class which appears in the Appendix. Each class member found interview candidates using a snowball approach, asked them the questions, record their answers, and summarized the answers to the discussion guide questions. The team then integrated the interview summaries into the final report including at least 1 verbatim comment from the interviews that supports conclusions concerning each question in the discussion guide. The answers to these questions informed the design and conclusions drawn from the Quantitative survey.

Quantitative Survey Concerning Specific Transfer Policies

Self-administered questionnaires (SAQs) were completed with AA Degree students, transferring undergraduate students, or community members returning to CCU using the same quota system as the one employed in the IDIs. This approach also involved a snowball sample and generated 300 completed questionnaires. The survey instrument is in the Appendix and covered demographics plus 11 main issues concerning transferring to Coastal Carolina University and degree completion appearing below:

1. Placement Test Required for Transfers to Get Core Classes Credit
2. No Foreign Language Required for Transfers
3. GPA of 2.5 Required for Transfers
4. Forgiveness of Tuition for Transfers Staying in SC After Graduation
5. Impact of Transfers on Value of Four Year Students Degrees
6. Jr. College Transfers Treated the Same as Four Year College Transfers
7. The Number of Transfer Students Should Be Capped
8. A General Business Degree Should Be Offered
9. A Variety of Degrees Should Be Offered
10. Difficulty in Getting Credits Transferred
11. Offering Weekend and Evening Classes to Encourage Transfers, Drop-outs, and Non-traditional Students to Enroll

Each of these 11 issues was measured on a 1 to 5 Likert scale where 1 indicates Not at all Important or Very Dissatisfied and 5 indicates Very Important or Very Satisfied concerning Coastal Carolina's policy on the issue. Following data collection and analysis of frequencies and crosstabs, BrandMap 7.0 was used to create Importance X Satisfaction Quadrant charts to show where Coastal Carolina needs to improve policies to attract more transfer students.

Summary of Key Findings

Qualitative Interviews

Summaries of the main issues covered in the IDIs appear below with supporting verbatim comments from participants.

Community member respondents are interested in a degree completion program because it will allow them to stay close to home while earning a bachelors degree. These respondents also believe a degree completion program will enhance Coastal Carolina University and bring in more out of state students; therefore bringing in more money and attention to the school.

Community members who do not want a degree completion program at Coastal Carolina University said that they would like to obtain their bachelors degree in a city or online due to convenience. These respondents had a "no effect" stand on the issue of the value of the degree.

"No harm, no foul"

Everyone was asked about the importance of the requirements to enter the degree completion program and whether or not a placement test should be implemented. All respondents agreed that requirements to get into Coastal were a major factor in the overall image of the school which allows the university to uphold a high academic standing. The placement test was an important factor to those respondents who felt that the tests would help the entering student to place out coursed they have already taken. Other respondents were opposed and said entrance should be based on transcripts alone.

"Everyone should be in the same boat."

Participants were asked whether or not they planned to stay in South Carolina after college and if an incentive, such as a tuition payback program, would encourage more graduates to stay. Those that claimed they were going to stay local had reasons such as family and prospective jobs. Others said that they planned to attend graduate school elsewhere, had worries about finding a job in the area, or simply had aspirations of moving to a new location.

“It would make more sense to stay, if there were more job’s available.”

Tuition payback changed many of the respondent’s perspectives on staying in South Carolina. Respondents felt that offering a tuition payback program would boost the local economy and decrease the stress of finding a job after college.

“With the unemployment rate so high, it would actually benefit the school to have that as an offer.”

Quantitative SAQs and Maps

In general, studies which focus on policies tend to focus solely on importance of policies or satisfaction with them and do not provide a complete picture of current policies and mission fulfillment. Evaluating importance and satisfaction toward policies are both relevant and need to be considered together. Taken separately, however, it can be difficult to convert such measures into practical strategic responses. The use of Importance-Satisfaction Analysis can help to avoid ‘missing the boat’ and demystify the results in such a way that policy-makers may more easily use the information provided for developing specific policy changes for their organizations.

Briefly, Importance-Satisfaction Analysis involves measuring the IMPORTANCE of and the SATISFACTION with a policy and then creating a graphical display of the results on a two dimensional (i.e., 2x2) "action grid," such as presented in Figure One. This action grid serves two important purposes. It offers an easily-interpreted visual display of both importance and satisfaction simultaneously. Secondly, and perhaps more importantly, it provides a basis for policy decisions (Chrzan and Malcom, 2003; Martilla and James, 1977; Abell, 1978).

Figure 1: Importance-Satisfaction Action Grid

HIGH Satisfaction	Possible Overkill	Keep Up the Good Work
LOW Satisfaction	Low Priority	Concentrate Here
	LOW Importance	HIGH Importance

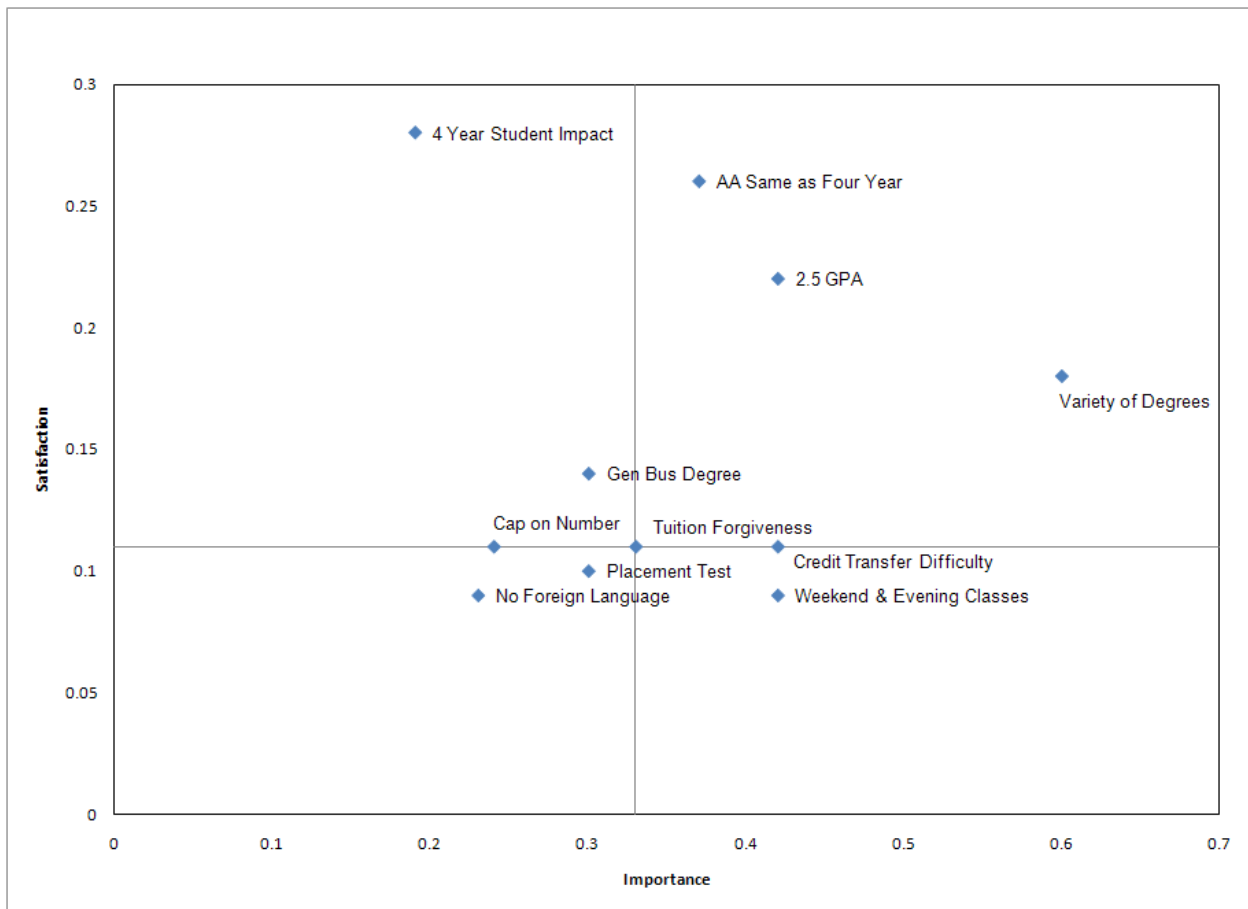
You can see the right half of the action grid represents policies which are perceived as high in importance

while the left half are those dimensions which are considered of lower importance. The top half of the matrix contains policies where satisfaction is perceived to be at higher levels whereas the bottom half of the action grid contains policies with lower satisfaction levels. The 2x2 Importance-Satisfaction action grid thus contains four quadrants:

1. **Concentrate Here** – High Importance, Low Satisfaction
2. **Keep Up the Good Work** - High Importance, High Satisfaction
3. **Low Priority** – Low Importance, Low Satisfaction
4. **Possible Overkill** - Low Importance, High Satisfaction

Figure 2 below shows the relationship of importance to satisfaction for the 11 policies in the total sample of 300. Since a traditional Gap Analysis using Brand Map uses only top – box percentages for both Importance and Satisfaction ratings on each of the 11 policies from the questionnaire, only those data are presented in Table 1 (see the Appendix) and used to construct Figure 2. A clustering of responses in the High-Importance / High-Satisfaction Quadrant is the desired outcome (e.g., keep up the good work!). It indicates polices focus on important matters.

Figure 2: Total Sample Map

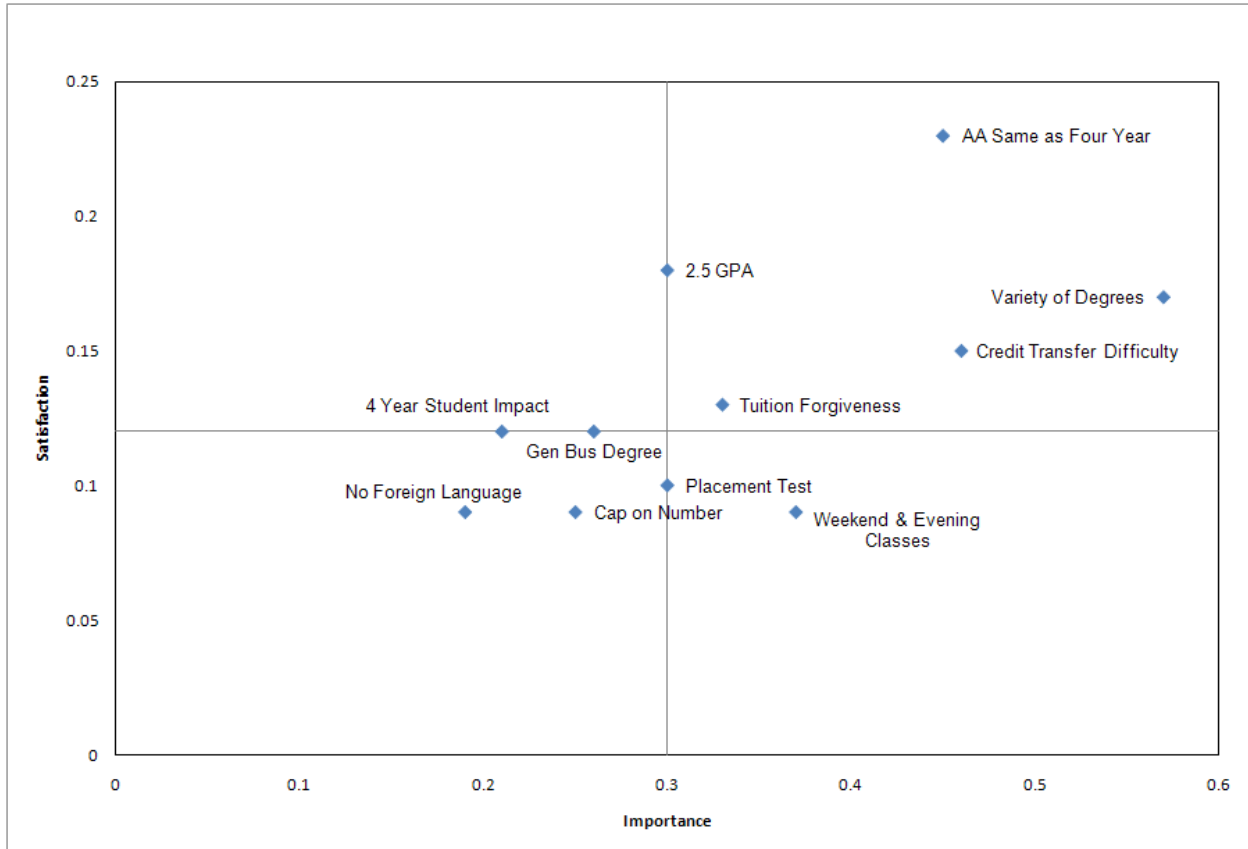


Overall, Coastal Carolina University needs to be concerned about the impact of offering weekend and evening classes and difficulties in transferring credits.

In addition to the Total Sample map, maps were generated for Two-Year Transfer Students, Four-Year Transfer Students, All Transfer Students, and No Transfer Students sub-samples. These maps are compared to see how these different student segments feel about the 11 policies.

Figure 3 below shows the relationship of importance to satisfaction for the 11 policies in the total sample of 110 students who have transferred after getting a two-year degree.

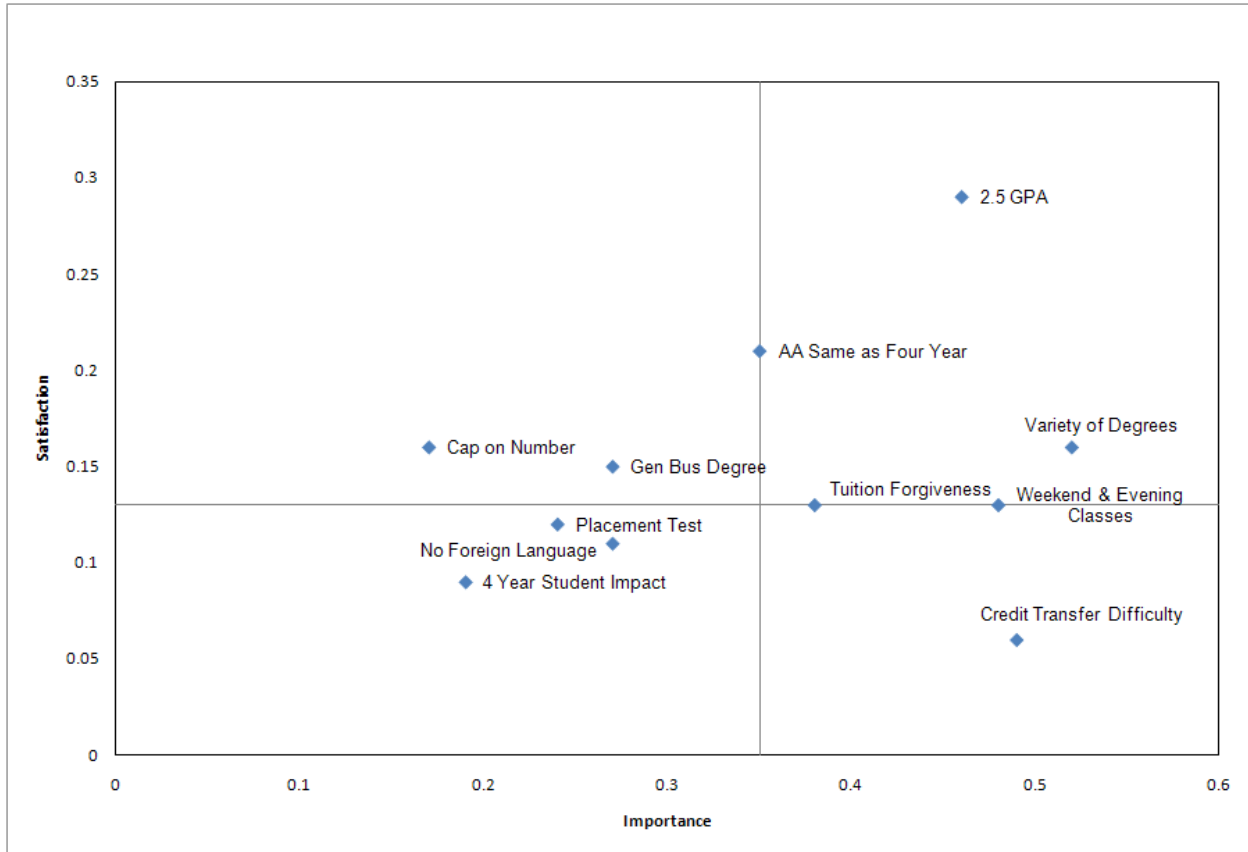
Figure 3: Two-Year Transfer Student Map



Compared to the total sample, these two-year transfer students more strongly feel CCU needs to be concerned about the impact of offering weekend and evening classes. They are relatively satisfied with two-year students being treated the same as four-year students, the variety of degrees, credit transfer difficulties and tuition forgiveness.

Figure 4 below shows the relationship of importance to satisfaction for the 11 policies in the total sample of 85 four-year transfer students.

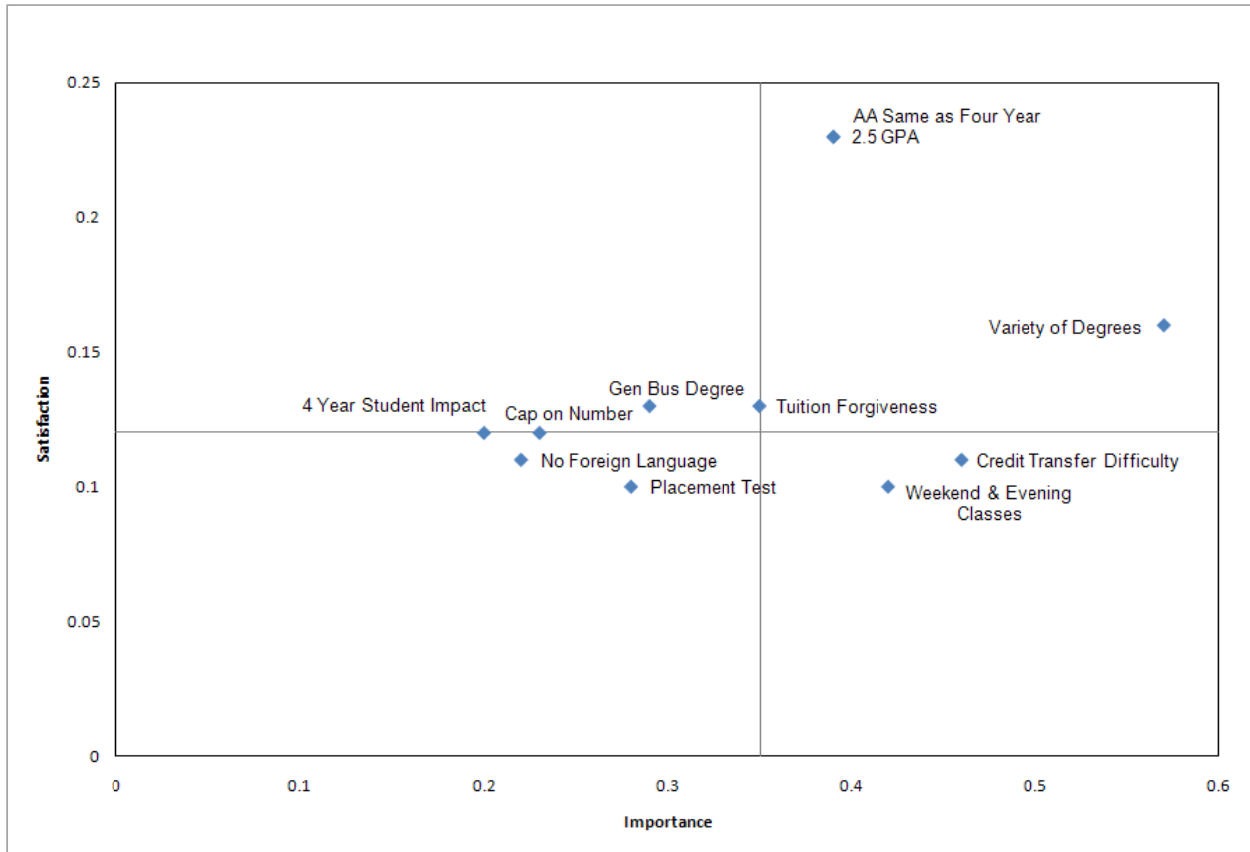
Figure 4: Four-Year Transfer Student Map



Compared to two-year transfer students, these four-year transfer students are more concerned about the impact of the 2.5 GPA transfer requirement and are relatively satisfied with the current policy. They also are much less satisfied with difficulties in transferring credits. They are indifferent to two-year transfer students being treated the same as four-year transfer students.

Figure 5 below shows the relationship of policy importance to satisfaction for the 11 policies in the sample of 169 all transfer students.

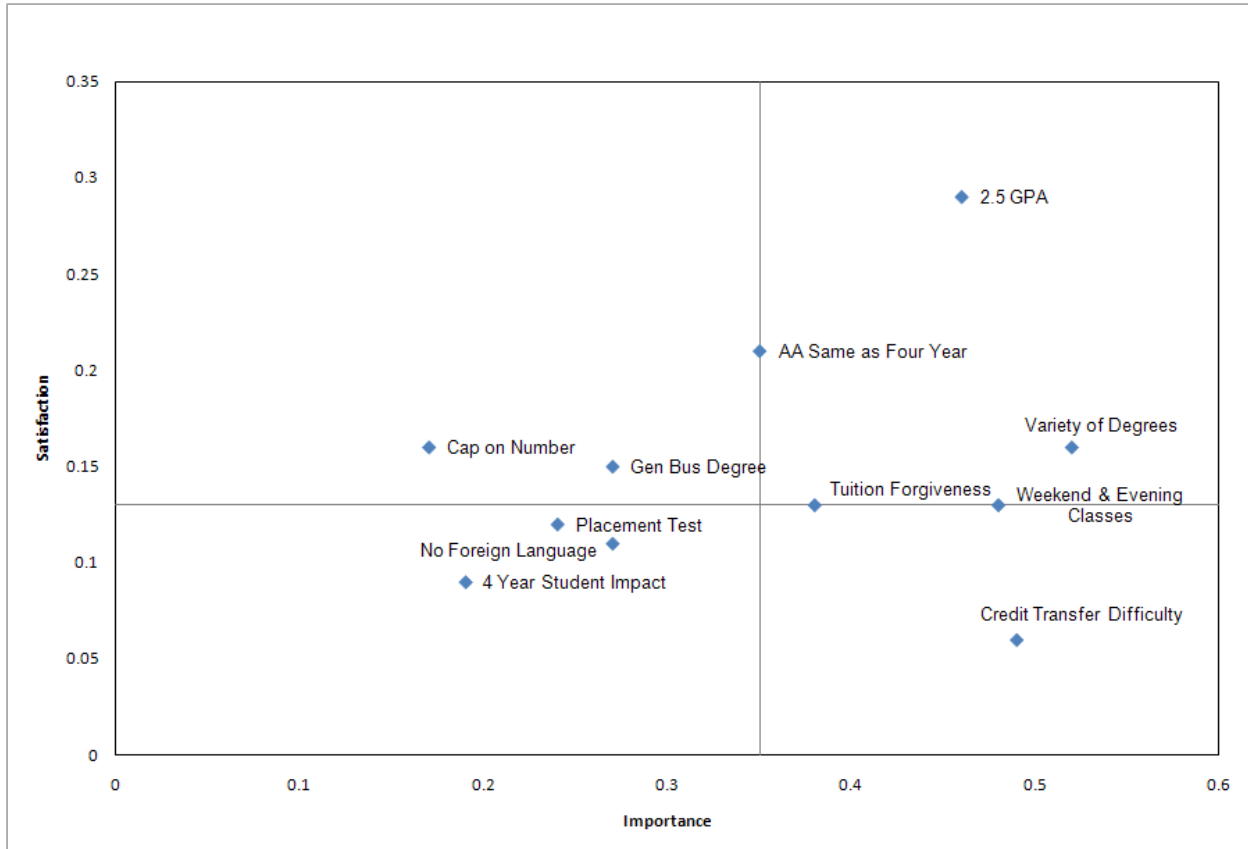
Figure 5: All Transfer Student Map



Compared to the total sample, this sample of all transfer students feel CCU needs to work on offering more weekend and evening classes and making it easier to transfer credits.

Figure 6 below shows the relationship of policy importance to satisfaction for the 11 policies in the sample of 126 students who have not transferred.

Figure 6: No Transfer Student Map



Although these students have not transferred, they also think CCU needs to work on credit transfer difficulty.

Conclusions and Recommendations

After reviewing the results above, the general conclusion is that a comprehensive degree completion program would benefit Coastal Carolina University and its community members. In general, it is recommended that the program is designed around more weekend and evening classes, and easy credit transfer rules. In addition, jobs in the area that are in high demand need to be matched to degree programs along with offering more internship opportunities and incentives for staying in South Carolina after graduation, and allowing for flexible time schedules of classes as well as expanding the online class availability.

More specifically, Myrtle Beach is not an ideal place to live after graduation. Students outside the education major find it very difficult to find jobs because Myrtle Beach is not a major city where a lot of jobs can be found. However, Coastal Carolina University can change this perception by doing a few things differently. If CCU were to offer the ability for students to have

jobs right after graduation, more students are likely to stay. Also, if CCU offers a degree completion program, more students are willing to come to Coastal.

In order to offer a degree completion program, CCU needs to follow a few guidelines. Coastal Carolina University needs to only admit students who have completed the necessary core classes with appropriate grades. If they do not have the appropriate grades, transfer students should be required to take a placement test that will allow them to test out of core classes if they meet or exceed the Coastal Carolina University standards. If too many people meet these requirements it is necessary to put a cap on how many students are allowed in each semester. There is a strong desire to look at the student-teacher ratio so that class sizes will stay relatively small. This will allow Coastal to see how quickly it can grow and expand.

Below there are a few suggestions for the ideal degree completion program.

The ideal degree completion program will be designed on the following items:

- where jobs are needed
- the ability to only take major classes and not core classes
- requiring each student to have an internship
- the ability for credits to transfer more easily
- offer incentives for those that stay in SC after graduation
- keep classes sizes small
- tuition must be reasonably priced
- make course hours more flexible and offer more online courses

The degree completion program will be great for Coastal Carolina University to increase the number of transfer students. However, CCU would like to see students stay in South Carolina after graduation. Coastal needs to engage in the process of helping students receive jobs right after graduation. This will boost the economy and create less stress on students finding jobs. Also, Coastal Carolina University needs to offer more degrees to include professions that are growing in demand, such as; engineering, pre-med, pre-law, and public relations. By offering more degree programs, CCU will be appealing to more people, causing a quicker growth rate.

In conclusion, it is recommended that Coastal Carolina University offer more programs that are in demand, help students get into Coastal Carolina University with fewer hurdles to go over, require internships that will help students get a job after graduation. If Coastal can implement these elements, students will be more likely to get a job in South Carolina and live and work here.

Limitations

This research has some limitations in terms of design and execution. Because the project was done as part of a Marketing Research class, some short-cuts were taken including:

- Snowball Convenience Sampling provided bias
- Was not simple random sampling making statistical tests unavailable

- Had time constraint of two months
- Sample size is too small to generalize to the population

However, the conclusions provide some guidance to the client, Dr. David Evans, Associate Provost of the Bridge Programs.

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www.sctrac.org (The South Carolina Transfer and Articulation Center (SC TRAC) was created as a one-stop shop for transfer students, administrators and advisors/faculty. It was developed by a collaboration of partners, including the South Carolina Commission on Higher Education (CHE) and representatives from the state's public institutions of higher education)

Appendices

Indepth Interview Discussion Guide

Current Students

1A. Did you start at CCU as a freshman or did you transfer to CCU?

Why did you transfer to CCU?

Where did you go to school before CCU?

1B. Do you plan to stay in South Carolina after graduation? Why or why not?

Community Members

1B. Would you be interested in a Degree Completion Program at CCU? Why or why not?

Transfers and Community Members Only

2. Currently, students who earn a Bachelors Degree in Education have their tuition paid if they stay in South Carolina to teach for two years after they graduate. If a Degree Completion Program was available at CCU, how important would it be to have a tuition repayment if a graduate stayed in South Carolina to work after graduation? Why or why not?

3.How important are the requirements for admission to CCU to earn a degree completion Bachelors Degree at CCU?

3A. Would these requirements be the same for students with an AA degree from an accredited junior college, a student from another four year university, and a student from the community who has some college experience after high school? Why or why not?

3B. Should an entrance exam or placement test be required to waive general core courses? Why or why not?

3C. Should there be a cap on the number of students allowed to enter CCU in any semester? Why or why not?

4. CCU now has such a program in Nursing. What other majors should be offered in a Bachelors Degree Completion Program? Why would those be important?

MAJOR 1:

MAJOR 2:

MAJOR 3:

5. If a degree completion student earned a degree in one of our current majors, say Bachelors of Science in Business Administration in Marketing. What effect, if any, do you think that would have on students who entered CCU as freshmen and completed all the standard requirements for that degree at CCU? Why would you say that?

DEVALUE:

NO EFFECT:

ENHANCE:

6. If you could design an 'IDEAL' Degree Completion Program, what would it look like?

THANK YOU FOR SHARING YOUR TIME AND OPINIONS WITH OUR MARKETING RESEARCH CLASS.

CCU Degree Completion Program and You

Below is a list of issues concerning transfer students completing degrees at Coastal Carolina University. Please tell us the RELATIVE LEVEL OF IMPORTANCE of each Factor in your opinion of degree completion programs for transfer students at CCU. Next, please tell us your RELATIVE LEVEL OF SATISFACTION with CCU's degree completion programs for transfer students on each Factor.

Circle the number in the boxes below for each Issue listed to indicate your answers.

NOTE: You should provide TWO answers for each Issue listed ... one for IMPORTANCE X and one for SATISFACTION by circling the appropriate number.

Degree Completion Program Issue	How Important is Each Issue In Your Opinion of CCU Degree Completion Programs?					How Satisfied Are You With CCU's Degree Completion Program Issue?				
	Not Important At All = 1	Not That Important = 2	Neutral = 3	Somewhat Important = 4	Very Important = 5	Very Dissatisfied = 1	Somewhat Dissatisfied = 2	Neutral = 3	Somewhat Satisfied = 4	Very Satisfied = 5
1 Placement Test Required for Transfers to Get Core Classes Credit	1	2	3	4	5	1	2	3	4	5
2 No Foreign Language Required for Transfers	1	2	3	4	5	1	2	3	4	5
3 GPA of 2.5 Required for Transfers	1	2	3	4	5	1	2	3	4	5
4 Forgiveness of Tuition for Transfers Staying in SC After Graduation	1	2	3	4	5	1	2	3	4	5
5 Impact of Transfers on Value of Four Year Students Degrees	1	2	3	4	5	1	2	3	4	5
6 Jr. College Transfers Treated the Same as Four Year College Transfers	1	2	3	4	5	1	2	3	4	5

		<u>How Important is Each Issue In Your Opinion of CCU Degree Completion Programs?</u>					<u>How Satisfied Are You With CCU's Degree Completion Program Issue?</u>				
Degree Completion Program Issue		Not Important At All = 1	Not That Important = 2	Neutral = 3	Somewhat Important = 4	Very Important = 5	Very Dissatisfied = 1	Somewhat Dissatisfied = 2	Neutral = 3	Somewhat Satisfied = 4	Very Satisfied = 5
7	The Number of Transfer Students Should Be Capped	1	2	3	4	5	1	2	3	4	5
8	A General Business Degree Should Be Offered	1	2	3	4	5	1	2	3	4	5
9	A Variety of Degrees Should Be Offered	1	2	3	4	5	1	2	3	4	5
10	Difficulty in Getting Credits Transferred	1	2	3	4	5	1	2	3	4	5
11	Offering Weekend and Evening Classes to Encourage Transfers, Drop-outs, and Non-traditional Students to Enroll	1	2	3	4	5	1	2	3	4	5

Please Check the blank indicating the BEST answer to the following questions.

12. Are you currently a college student? [check one]
 Yes [Continue] No [Skip to Question 15]
13. Are you? [check one]
 At CCU At HGTC
 At another 4-yr. University At another 2-yr. College
14. What is your Class at your current school? [check one]
 Freshman Sophomore Junior Senior
 Grad Student None [non-degree]
15. What is your gender? [check one]
 Male Female
16. Do you pay in-state or out-of-state tuition? [check one]
 In-state Out-of-State
17. Did you transfer to CCU? [check one]
 Yes No
18. Where did you transfer from? [check one]
 A 2-yr. school A 4-yr. school
22. Please feel free to offer any additional comments below regarding attending Summer School at CCU.
19. What is your Employment Status? [check one]
 Full-time student with no job.
 Full-time student with a part-time job.
 Full-time student with a full-time job.
 Part-time student with no job.
 Part-time student with a part-time job.
 Part-time student with a full-time job.
 Not a student with no job
 Not a student with a part-time job
 Not a student with a full-time job
20. What is your housing Arrangement? [check one]
 I live on-campus in the dormitories.
 I live off-campus in CCU housing (University Place).
 I live off-campus in non-CCU housing (apartment, townhouse, etc).
21. Do you plan to stay in SC after graduation? [check one]
 Yes No

Table 1: Data Used for BrandMap 7.0 Maps

Total Sample	Chart 1 n=300	
	Importance	Satisfaction
Placement Test	0.3	0.1
No Foreign Language	0.23	0.09
2.5 GPA	0.42	0.22
Tuition Forgiveness	0.33	0.11
4 Year Student Impact	0.19	0.28
AA Same as Four Year	0.37	0.26
Cap on Number	0.24	0.11
Gen Bus Degree	0.3	0.14
Variety of Degrees	0.6	0.18
Credit Transfer Difficulty	0.42	0.11
Weekend & Evening Classes	0.42	0.09
2 Yr Transfer	Chart 2 n=110	
	Importance	Satisfaction
Placement Test	0.3	0.1
No Foreign Language	0.19	0.09
2.5 GPA	0.3	0.18
Tuition Forgiveness	0.33	0.13
4 Year Student Impact	0.21	0.12
AA Same as Four Year	0.45	0.23
Cap on Number	0.25	0.09
Gen Bus Degree	0.26	0.12
Variety of Degrees	0.57	0.17
Credit Transfer Difficulty	0.46	0.15
Weekend & Evening Classes	0.37	0.09

4 Yr Transfer	Chart 3	n=85
	Importance	Satisfaction
Placement Test	0.24	0.12
No Foreign Language	0.27	0.11
2.5 GPA	0.46	0.29
Tuition Forgiveness	0.38	0.13
4 Year Student Impact	0.19	0.09
AA Same as Four Year	0.35	0.21
Cap on Number	0.17	0.16
Gen Bus Degree	0.27	0.15
Variety of Degrees	0.52	0.16
Credit Transfer Difficulty	0.49	0.06
Weekend & Evening Classes	0.48	0.13

All Transfers	Chart 4	n=169
	Importance	Satisfaction
Placement Test	0.28	0.1
No Foreign Language	0.22	0.11
2.5 GPA	0.39	0.23
Tuition Forgiveness	0.35	0.13
4 Year Student Impact	0.2	0.12
AA Same as Four Year	0.39	0.23
Cap on Number	0.23	0.12
Gen Bus Degree	0.29	0.13
Variety of Degrees	0.57	0.16
Credit Transfer Difficulty	0.46	0.11
Weekend & Evening Classes	0.42	0.1

	Chart 5	n=126
	Importance	Satisfaction
No Transfers	0.33	0.1
Placement Test	0.25	0.05
No Foreign Language	0.46	0.2
2.5 GPA	0.31	0.09
Tuition Forgiveness	0.19	0.03
4 Year Student Impact	0.34	0.12
AA Same as Four Year	0.25	0.1
Cap on Number	0.29	0.15
Gen Bus Degree	0.64	0.21
Variety of Degrees	0.37	0.11
Credit Transfer Difficulty	0.44	0.09
Weekend & Evening Classes		

Financial Evaluation of the SC State retirement system

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ABSTRACT

This research analyzes the financial status of the State of South Carolina Retirement system to test the hypothesis that the State of South Carolina Retirement system is well managed and has adequately provided for its future pension obligations to its employees making it unnecessary to impose additional tax burdens on its residents.

Background

In February 2010 the Pew Research Center reported, the United States of America faced a one trillion dollar shortfall in their funds for employee and retirement benefits. Novy-Marx and Rauh (2009) calculated “two present value measures of already-promised state pension liabilities using discount rates that reflect the risk of the payments from a taxpayer perspective under different conditions. If benefits have the same default and recovery characteristics as general obligation debt, liabilities across all 50 states amount to \$3.21 trillion”. the authors further clarify that their calculation “probably understates the liability, because pension promises typically have higher priority than state municipal debt. Using zero-coupon Treasury yields, which are default-free but contain other priced risks that may not be relevant for pension liabilities, total liabilities are \$5.20 trillion. Liabilities are even larger under broader concepts that account for projected salary growth and future service.”

Research Summary

In this research the author examines the status of the South Carolina Retirement system in particular since the author is a resident of this state although not a member of the SC Retirement system. Pension obligations of the state are a legally binding obligation and a shortfall in allocations could result in higher taxes on SC residents going forward to fund the shortfall. This research analyzes the financial status of the State of South Carolina Retirement system to test the hypothesis that the State of South Carolina Retirement system is well managed and has adequately provided for its future pension obligations to its employees making it unnecessary to impose additional tax burdens on its residents.

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Novy-Marx, Robert and Joshua D. Rauh, 2009, Public Pension Promises: How Big are They and What are they Worth? NBER Working Paper

Testing Ayn Rand's Moral Foundations of Capitalism: 20 Testable Hypotheses on the Nature of Capitalism

1. Introduction

We plan to explore the moral foundations of Randian capitalism as Ayn Rand defined them and compare these ideas to several prominent western philosophical thinkers. We then plan to line these ideas up with real world economic variables and to test what it is possible to test. Is economic freedom good? Is it correlated with many of the goods we desire? Rand is often considered the modern-day voice of capitalism. She rejects the ever-increasing public sentiment of altruism and instead favors personal freedom, self-interest and the production of goods for profit. She rejects socialism and socialist ideals and fights for laissez-faire capitalism as first proposed in Adam Smith's *The Wealth Of Nations*, stating in her article, "The Roots of War" that "Laissez-faire capitalism is the only social system based on the recognition of individual rights and, therefore, the only system that bans force from social relationships, by the nature of its basic principles and interest".¹ Rand is very serious about her theory and we intend to lay out the full Randian case for liberty from the ground up.

2. Primary Research Question

Is the form of laissez-faire capitalism that Rand suggests ethically just? Is it ethical to reject the needs and wants and desires of others at the expense of one's own personal goals? In

¹ Rand, Ayn "Roots of War", *THE OBJECTIVIST* magazine, June 1966.

order to tackle this great question, it is necessary to establish the definition of “justice”.

Throughout the history of western philosophy, philosophers have debated this central concept of Justice. Plato’s Republic is likely the first systematic account. In order to examine and evaluate Rand’s philosophy, the first step must be to define her conception of Justice and to determine if it stands the test of human reason. What are the criterion for Rand’s definition of Justice? This analysis in section one of our paper will lead to further questions and tests.

3. Comparison to Other Philosophical Thought

The history of western philosophical thought contains within it at least 20 major definitions of justice; Marxist Justice, Feminist Justice, Kantian Justice, Communitarian Justice, Libertarian Justice, Christian Justice etc...Kant is likely the seminal philosopher of our day on the subject of justice, with major disciples at all major universities in the United States. John Rawls of Harvard is likely his star pupil. Rawls is a proponent of the equalization of all rights and goods and liberties and through his metaphor of the “veil of ignorance”, he creates a philosophical base from which everyone would argue for a “fair” distribution”. It turns out that that “fair” distribution results in either a very mixed form of capitalist economy or a socialist system, and Rawls is pretty up front about that outcome. He thinks it is fair and just.

Rand thinks that Kant and his followers are responsible for the major errors in the theory of knowledge and in the theory of ethics. Her views are addressed explicitly in her most famous novel *Atlas Shrugged*. For now we will just say that in Rand, socialism causes even Atlas to Shrug. It does not work. No claim can ever be made on one individual by another individual or the state, and any such intervention is obviously an affront to individual rights.

3. Basis of Randian Capitalism

Rand follows Adam Smith, the father of Western capitalism, as he expresses in his text, *Wealth of Nations* that people need to be self-sufficient. He states that "Nobody but a beggar chooses to depend chiefly upon the benevolence of his fellow-citizens. Even a beggar does not depend upon it entirely."²

In modern society, by contrast, citizens seem to have the complete opposite view. Relying heavily on the benevolence of fellow citizens, many members of today's society seem to think that through government intervention, they will be provided with any and everything that they think they deserve; unemployment insurance, health insurance etc. Most of the elected officials in government seem to encourage this thinking too, proposing fanciful false promises in order to be elected. It is a shame that these Americans, who seem to believe that they are entitled were not alive to hear former president Grover Cleveland announce that "though the people support the government, the government should not support the people."³ That was only about a century ago. James Madison who penned the Constitution also argued that it is hard to find a line in the Constitution which promises benevolence from the state to the individual. Now over half the federal budget is precisely a payment from the state to the citizen, and half of the citizenry does not pay taxes, precisely the group who receives most of the goods. Is this ethical? Rand would say no. Kant can be read several ways. Rawls would say yes.

4. The United States of America

The 2010 Index of Economic Freedom currently has the United States ranked the eighth most economically free country in the world, but we have fallen from higher rankings in the past.

² Smith, Adam. *Wealth Of Nations*. 5th ed. London: Methuen & Co., Ltd., 1904. N. pag. Library Of Economics and Liberty . Web. 3 Mar. 2010. <<http://www.econlib.org/library/Smith/smWN.html>>.

³ Grover Cleveland, 22nd and 24th president of The United States of America

This downward trend is considerably steeper than any other trend for the top ten nations, and seems to contradict the American mantra “land of the free”. As the government continues to raise taxation and restrict business freedom, Americans will continue to see their personal freedoms to produce and spend decline while an overbearing government grows larger and larger.⁴ Can we link Randian philosophical claims to these empirical realities?

Thanks to a recent major study by the World Bank, a host of new freedom indexes are available which makes it possible to correlate economic freedom to a host of other dependent variables such as: life span, health, education, gender roles, race issues, standard of living. The final section of our paper will present over 20 falsifiable/testable claims relating capitalism to these other dependent variables. We should note that Capitalism is not always a positive force. We anticipate that Capitalism has had a negative effect on the family structure in the West, but we will see.

5. Conclusion

There are obviously arguments for and against capitalism and there are both societal advantages and disadvantages to such a system. I plan to examine these advantages and disadvantages; examining whether in fact the advantages of competition and the free market system that Rand so strongly advocates in both her pieces of fiction and nonfiction outweigh disadvantages of capitalism. For Rand, this is almost the case by definition, but social science must to better. The debate must be put forward in falsifiable and testable terms.

⁴ "2010 Index of Economic Freedom World Rankings." *Index of Economic Freedom*. Ed. Jim Weidman. The Heritage Foundation, 2010. Web. 28 May 2010. <<http://www.heritage.org/index/>>.

IS INFLATION VOLATILITY CORRELATED FOR THE US AND CANADA?

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ABSTRACT

This paper investigates the behavior of inflation over the recent past for the US and Canada with primary focus on volatility, not the level of inflation. Over the past 35 years, the inflation rates for this pair of nations have shown periods of tranquility as well as periods of volatility. Recent evidence suggests that inflation, after a period tranquility during the 1990s for the US and for Canada, became more volatile early in the new century (perhaps even as early as 1999)—prior to the volatility in the energy and food sectors. Evidence of the volatility is presented and is modeled with relatively simple autoregressive conditional heteroskedasticity (ARCH) models. The resulting series on volatility are then compared across the US and Canada.

INTRODUCTION

The autoregressive conditional heteroskedasticity (ARCH) model was developed by Robert Engle to explain volatility “clustering,” that is, periods in which the variance of a time series is tranquil and other periods in which the variance of the series is more volatile. The ARCH model and its extension, generalized ARCH (GARCH), have been applied to numerous economic and financial series. These models are important in identifying periods of volatility and they also aid in producing more realistic interval forecasts.

DATA, METHOD, RESULTS

For this project monthly measures of the Consumer Price Index (CPI) for the period January 1974 to December 2009 were collected for both nations. The series are for “headline” inflation rates, not core inflation. The start date was chosen to coincide with the end of the Bretton Woods fixed exchange rate era. The measure of inflation is the monthly log difference in the CPI at annual rates. Those series are shown in Figure 1 for the US and in Figure 2 for Canada.

Casual observation of Figures 1 and 2 suggests that inflation was more volatile in the late 1970s and again in the 2000s for both nations, though the volatility in the 2000s seems somewhat greater for the US (note that the left-hand scales are not the same between the graphs). Periods of tranquility were evident in the 1990s for both nations. Canada also experienced a more tranquil period than the US from about 1984 until 1990. The spike in Canadian inflation evident in 1991 was distorted by the institution of the federal GST (Goods and Services) tax.

It is well known that simple inspection of the variance of a series can be misleading when the series is autocorrelated. To correct for this, an autoregressive model is fit to the inflation rate. The lags are chosen using standard penalized likelihood model selection criteria. The form of the autoregressive model can be represented as follows:

$$INFL_t = a_0 + \sum_{i=1}^p b_i INFL_{t-i} + e_t \quad (1)$$

Figure 1: Monthly US Inflation at Annualized Rates

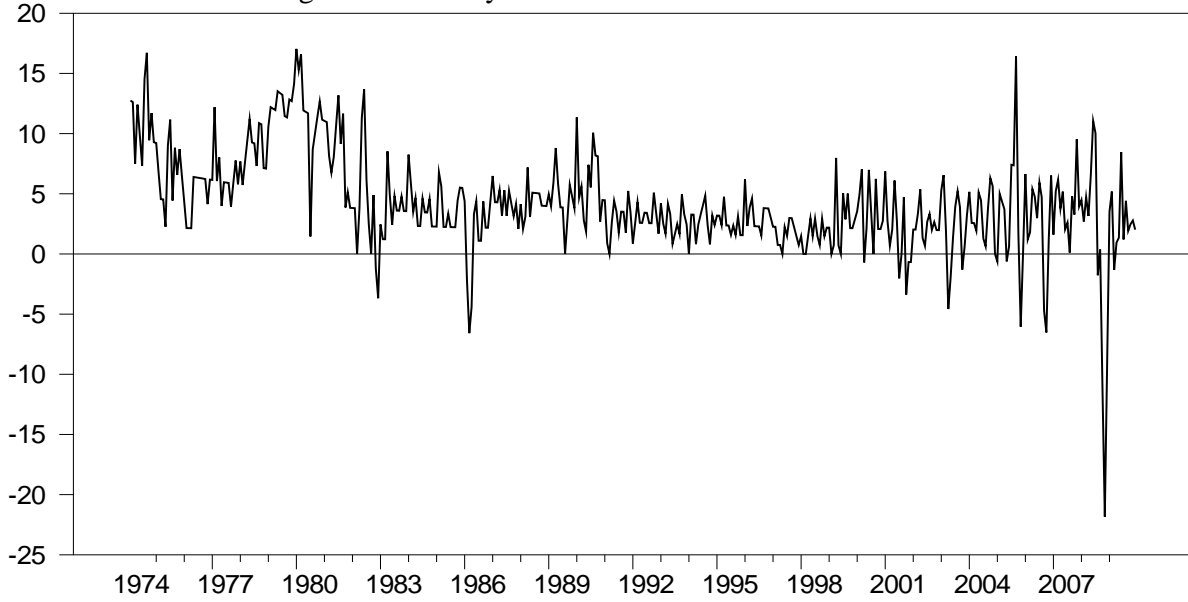
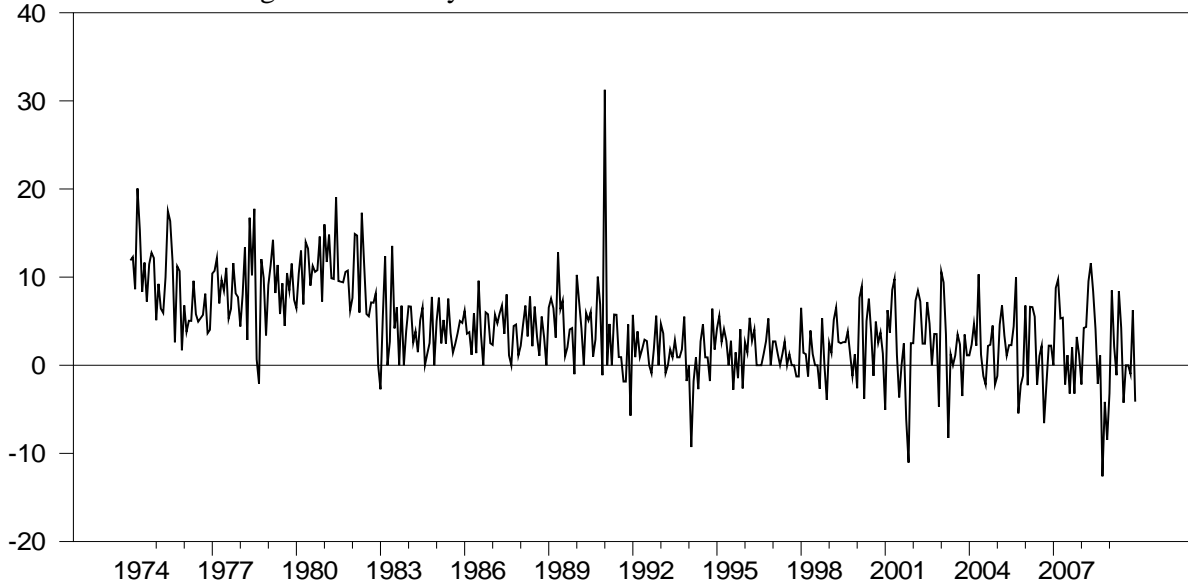


Figure 2: Monthly Canadian Inflation at Annualized Rates



where $INFL$ is annualized monthly inflation, t indexes time, e_t is a white noise disturbance term and the b_i ($i = 1, \dots, p$) are the lag coefficients, and p indicates the order of the lags. The two standard penalized likelihood selection criteria are the Akaike information criterion (AIC) and the Schwarz information criterion (SIC) represented as follows:

$$AIC = (2k / T) + \log(\sigma) \quad (2)$$

$$SIC = [k \log(T) / T] + \log(\sigma), \quad (3)$$

where k is the total number of estimated coefficients in the equation, T is the number of usable observations, and σ is the scalar estimate of the variance of the equation's disturbance term. If the AIC and the SIC differ on the number of lags, each indicated model was estimated, with evidence presented here for the most parsimonious model. The SIC chooses $p = 2$ for the US and $p = 12$ for Canada. Additional analyses are based on those estimated models.

Figure 3: Residuals From the AR Model for the US

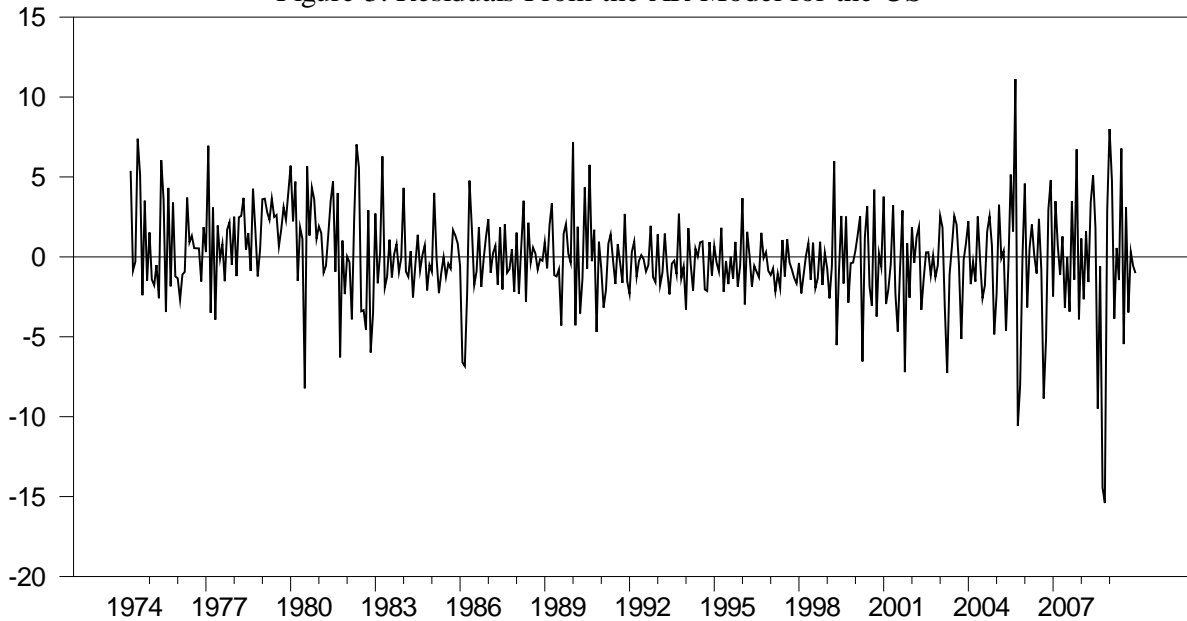
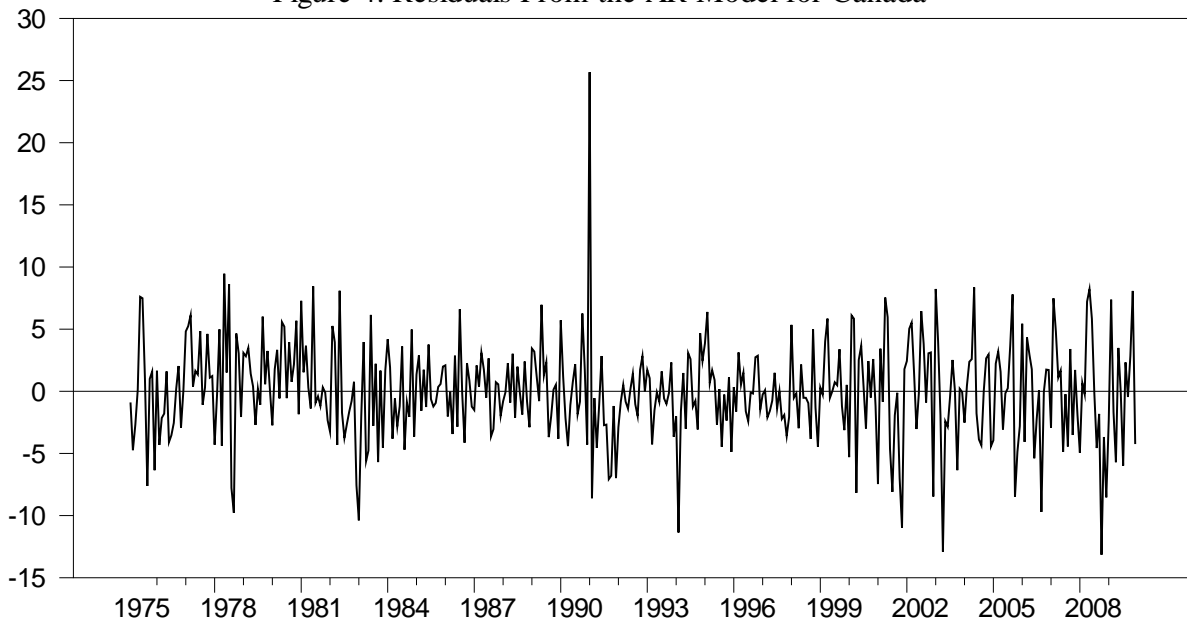


Figure 4: Residuals From the AR Model for Canada



The residual series from the autoregressive models are presented in Figures 3 and 4. These series are often considered a close approximation of the volatility of the series, since the models control for autocorrelation. Figure 3 suggests the same evident patterns of volatility for the US. Figure 4, for Canada, is less clear. An increase in volatility seems to be evident after 1999 for Canada, but it appears less pronounced than that for the US.

Figure 5: Squared Residuals From the AR Model for the US

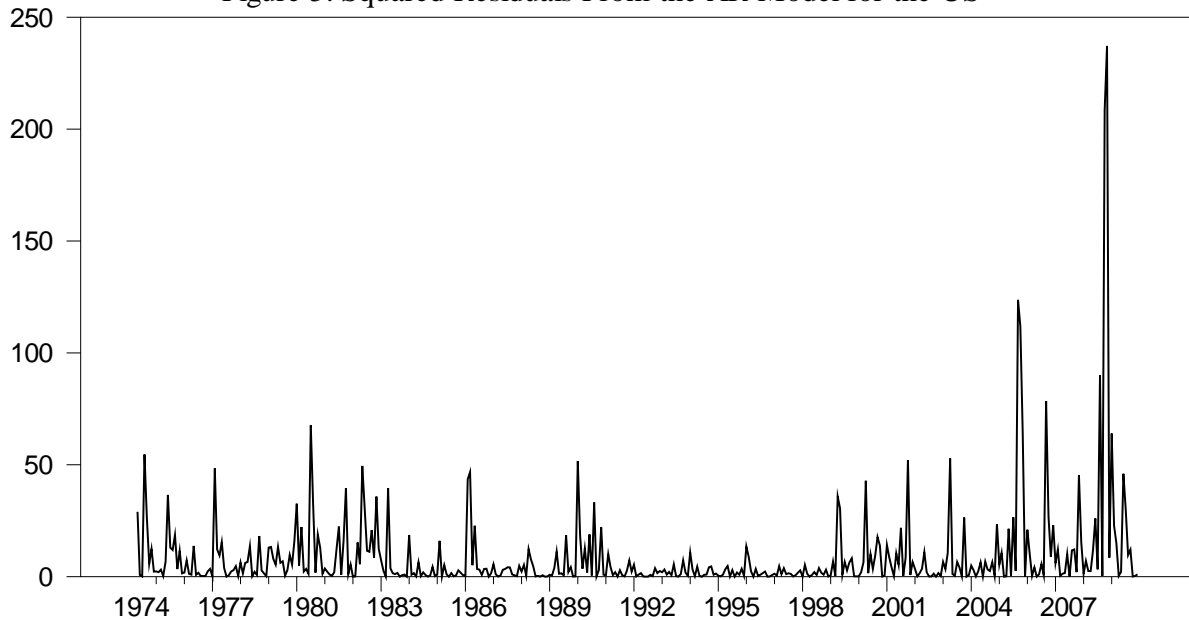
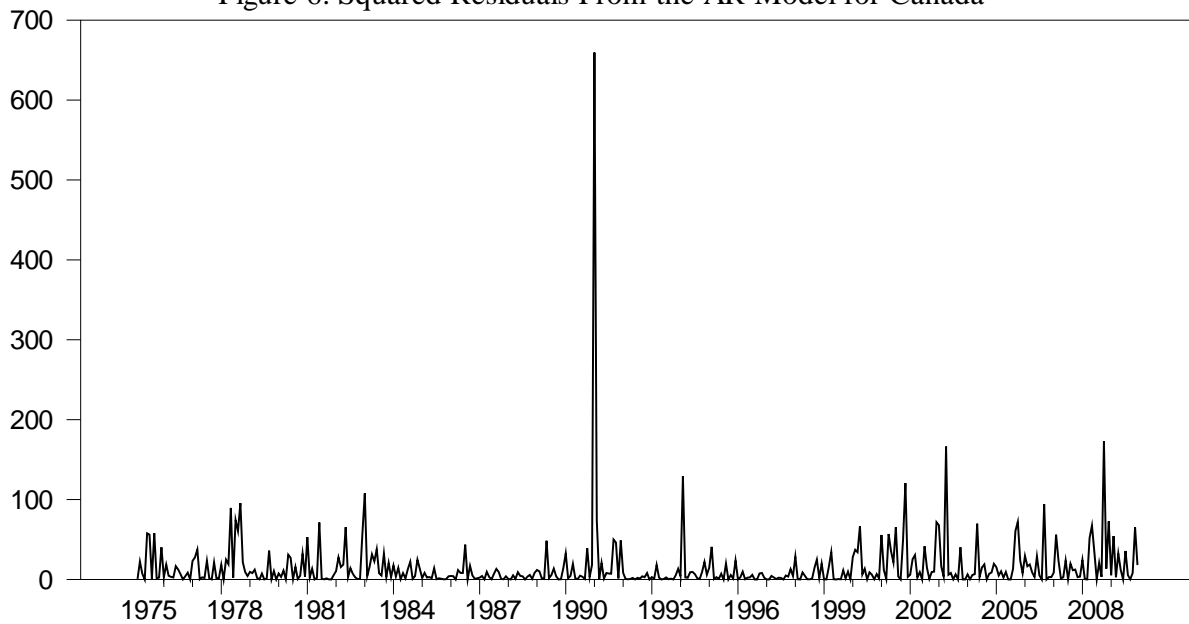


Figure 6: Squared Residuals From the AR Model for Canada



Examining the squared residuals in Figures 5 and 6 may be more revealing. Figure 5 shows a definite pattern of clustering of volatility for the US, with evident tranquility in the 1990s, followed by a persistently greater volatility following 1999. For Canada, if the spike in 1991 is ignored, the period from 1984 until 1999 would appear to be one of tranquility, followed by an increase in volatility thereafter.

Testing for volatility is usually accomplished by analysis of the squared residuals from an autoregressive model, such as those depicted in Figures 5 and 6. The reasoning for testing the squared residuals is simple. The residuals from the autoregressive model (see Figures 3 and 4) will be serially uncorrelated as a result of the autoregressive lag fit. Those residuals are, however, not independent. Small (in absolute value) residuals are likely to be followed by additional small residuals, and large residuals are likely followed by other large residuals—that is the meaning of volatility clustering.

To test for ARCH errors, a second regression is run:

$$e_t^2 = c_0 + \sum_{i=1}^p d_i e_{t-i}^2 + v_t \quad (4)$$

Where e_t^2 represents the squared residuals from equation 1, and the d_i ($i = 1, \dots, p$) are lag coefficients and p again indicates the order of the lags. If there are no ARCH effects, then equation 4 will have little explanatory power, i.e., R^2 will be very low. The existence of ARCH effects can be tested in two ways. First with a sample of T residuals, TR^2 is distributed as χ^2 with p degrees of freedom. Alternatively, an F -test that all d_i coefficients are jointly zero will also indicate whether or not ARCH effects are present. The SIC chooses 2 lags for equation 4 for the US and only 1 lag for Canada.

The estimated equations for (4) are:

$$\begin{aligned} \text{US:} \quad \hat{e}_t^2 &= 4.94 + 0.35 \hat{e}_{t-1}^2 + 0.08 \hat{e}_{t-2}^2 & (4') \\ R^2 &= 0.152 \\ T &= 426 \end{aligned}$$

The null hypothesis of no ARCH effects can be written:

$$\begin{aligned} H_0: & d_1 = d_2 = 0 \text{ (there are no ARCH effects)} \\ H_1: & \text{some } d_i \neq 0 \text{ (there are ARCH effects)} \end{aligned}$$

As expected, the null hypothesis is rejected resoundingly for either the χ^2 test ($\chi^2 = 66.46$, p-value = 0.0000), or the F -test ($F_{(df=2,423)} = 39.10$, p-value = 0.0000). We conclude that the process of inflation for the US is subject to ARCH effects. Thus we have confirming statistical and visual evidence that small squared residuals tend to be followed by small squared residuals, and large squared residuals are more often followed by other large squared residuals.

$$\begin{aligned} \text{Canada:} \quad \hat{e}_t^2 &= 14.39 + 0.09 \hat{e}_{t-1}^2 & (4'') \\ R^2 &= 0.0054 \\ T &= 418 \end{aligned}$$

Here finding in favor of *ARCH* is a little more ambiguous. Because the equation contains only one lag for squared error series, the above tests are equivalent to the t-test on the slope coefficient. That t-score is 1.8 with a p-value of 0.072. A tentative conclusion can be offered: *ARCH* effects likely exist for Canadian inflation but are much weaker than in the case of the US.

OTHER RESULTS

The *ARCH* errors model is typically estimated simultaneously with the autoregressive model of inflation by maximum likelihood methods. That estimation also yields an estimate of the variance of the series, typically known as the *h* series. Again choosing the same values *p* for the autoregressive presentation for inflation, and for the variance of the series of each nation, we present the portion of the equation that represents the variance (here, *h*) of the inflation series (here we are less interested in the autoregressive parameters of the estimate of inflation, since many, many, alternative inflation forecasting models are possible):

$$US h_t = 1.08 + 0.20 \hat{e}_{t-1}^2 + 0.26 \hat{e}_{t-2}^2 \quad (5)$$

(3.56) (4.22)

$$Can h_t = 0.43 + 0.25 \hat{e}_{t-1}^2 \quad (6)$$

(2.60)

Where *h* is the estimated conditional variance in inflation and the numbers in parentheses are t-statistics. Equation 6 suggests stronger *ARCH* effects for Canada than did the prior section.

To summarize the results of this section, we find in favor of *ARCH* effects for the inflation series of both nations. The statistical and visual evidence are very clear for the US, weaker for Canada.

TWO TESTS OF VOLATILITY RELATIONSHIPS ACROSS THE US AND CANADA

There are at least two potential tests for the correlation of volatility across nations. First, the hypothesis that the residual series are correlated is entertained, and second, a test for dependence in the squared residual series is run. The results of such tests will lead to conclusions regarding whether shocks to the inflation series which result in changes in volatility are coordinated across these two nations, and the lag/lead nature of such coordination, should it exist.

Recall that the residual series derived from models represented by equation 1 above are not autocorrelated. The series may be, however, correlated with the residual series from the “other” nation. For example, the residual series from the US, though not autocorrelated, may be correlated with the residual series from Canada. This hypothesis is tested with each nation’s residual series as the dependent variable. Here I choose arbitrarily leads and lags of a maximum of 3. For example, with the US residual series as the dependent variable, the representative regression is:

$$\hat{e}_t^{(US)} = c_0 + \sum_{i=-3}^{+3} d_i \hat{e}_{t-i}^{(C)} + v_t, \quad (7)$$

with the US and C reversed for the second regression. The result of those two estimations can be described as follows. First, the residual series is most strongly correlated at the contemporaneous month,

that is, at lag = 0, and as expected the relationship is positive. Second, the US residual series is correlated with the residuals for Canada at lead = 1. That is, US volatility leads Canadian volatility. That result is confirmed for the case with the Canadian residual series serving as the dependent variable, where at lag = 1, the US residual series is related to Canadian volatility. No other lag (or lead) is statistically significant. These results indicate that inflation volatility, measured by the residual series from separate autoregressions, is correlated between the US and Canada, and further that US volatility leads Canadian volatility.

Further evidence on volatility dependence across the US and Canada can be tested via traditional vector autoregressions (VARs) for the squared residual series. Equations 4' and 4'' already established that volatility is subject to clustering for both the US and Canada, thus accounting for “own” lags will allow testing for Granger [6] causality *across* the two nations via lagged variance series of the other nation. Such a formulation can be represented as:

$$\hat{e}_t^{2(US)} = a_0 + \sum_{i=1}^p b_i \hat{e}_{t-i}^{2(US)} + \sum_{i=1}^p c_i \hat{e}_{t-i}^{2(C)} + v_t, \quad (8)$$

and, of course, the Canadian squared residuals $\hat{e}_t^{2(C)}$ also serves as the left-hand side variable. The test for Granger causality is an F-test that the b_i coefficients are zero, and another F-test that the c_i coefficients are zero. The AIC and the SIC differ on the number of lags (p), with the SIC choosing $p = 1$, and the AIC choosing $p = 12$. Each of those estimations yields the same general conclusion. If the dependent variable is $\hat{e}_t^{2(US)}$, then lagged US variance causes (in the sense of Granger) US variance in the current time period, but Canadian lagged variance does not. In the case of Canadian variance in inflation, neither lagged series is important in predicting the current variance in inflation.

Table I: F-tests for $p = 12$

Dependent Variable	Explanatory Variables	
	Lagged U.S. variance	Lagged Canadian variance
U.S. variance	7.982* (0.00)	0.577 (0.86)
Canadian variance	1.322 (0.20)	0.616 (0.828)

(p-values in parentheses)

Table II: F-tests for $p = 1$

Dependent Variable	Explanatory Variables	
	Lagged U.S. variance	Lagged Canadian variance
U.S. variance	67.02* (0.00)	2.53 (0.111)
Canadian variance	0.828 (0.364)	2.54 (0.112)

(p-values in parentheses)

The more parsimonious estimations in Table II give similar results, though the lagged values of the Canadian series come closer to meeting tests for statistical significance.

ECONOMICS OF INFLATION VOLATILITY ACROSS NATIONS

Economists have long believed that a stable inflation rate is one of the keys to a smoothly functioning macro economy (see [5], for example). It follows that inflation volatility can be a source of economic instability. The possible sources of inflation instability include exogenous price shocks, speculative bubbles, monetary policy, and even openness in trade and capital flows. Why then might inflation volatility be synchronized across nations? First exogenous price shocks—for example to food and energy—may be felt across nations, though the effects on the individual economies may (of course) differ. The same can be argued for speculative bubbles. Second, monetary policies may be coordinated across nations, with the result that periods of tranquility (and volatility) are similar. Third, shocks that originate in one nation may affect inflation in other nations through trade and capital flows as well.

CONCLUSIONS

This research finds in favor of modeling inflation in the US and Canada as *ARCH* processes, though the evidence is stronger for the US. The cross country tests for correlation of inflation variance yields two important results. First, US and Canadian inflation volatility, measured as the residuals from autoregressive representations, are correlated in the contemporaneous month and there is evidence that US volatility leads Canadian volatility by one month. Second, when volatility is measured as the squared residuals from the autoregressive representation, the evidence for cross country Granger causality is weak. The latter would suggest that prediction of volatility for, say, the US would not be aided by modeling lags of Canadian volatility.

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Assessing the Validity of Financial Measures in Predicting the Riskiness of NASDAQ Stocks During the Market Downturn of Year 2008

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Abstract

The purpose of this study is to assess the validity of financial measures in predicting the riskiness of NASDAQ stocks' price movement during the market downturn of year 2008. A study by Bahhouth et.al. (2010) showed evidence that beta had a marginal effect in identifying risky stocks during the market turndown of year 2008; the study was based on all stocks listed on S&P500 Index. The purpose of this study is to cross examine the significance of beta and financial measures in predicting stocks' riskiness when applied to other market segments; it is based on NASDAQ stocks during the same downturn period of 2008. In explaining the research problem, Logistic regression is used. The study shows evidence that P/BV, P/E, and DSC had marginal effect in predicting NASDAQ stocks' price movement during year 2008 downturn.

Introduction

In the last decade two stock market crashes shook the financial markets. The first one occurred in year 2000, where the stock market lost more than 40% of its value. The crash destroyed more than \$8 trillion in investors' wealth; its effect was devastating on all industries at all levels (Nofsinger, 2001). The other one occurred

in year 2008, where the stock market lost more than 50% of its value and shook the global economy.

Stock market crashes have been the center of discussion for a long time. Researchers gave different explanations of the factors that are causing them. Roll (1989) suggested that crashes occur because of the revised expectations of the worldwide economic activity. Others highlighted that stock prices swing from fundamental values because of the trading activities of the uninformed investors (Shiller, 1984).

Zuckerman E. and Rao H. (2004) related the market crash of year 2000 to the main features of trading in technology stocks early in the 1990s. Investors and stock traders were not able to explain the implications of the rise and fall of the Internet stock for many years. Ofek and Richardson (2003) pointed out that during that period, the very high volume of trade in Internet stocks indicated a wide gap between the prices and their fundamental values. Demers and Lev (2001) gave two broad reasons for how Internet stocks reached unjustifiably high prices in the late 1990s and early 2000. The first focuses on the fundamental values that highlight the elements of capital gains and losses. Investors change their opinion often based on indicators rather than on fundamental values. The second suggests that fundamentals were indeed responsible for market prices but investors' interpretations of fundamentals were irrationally optimistic in making their assessments.

NASDAQ composite index was mainly affected because it is mainly denominated by IT companies. The effect of that crash started in March 2000 continued with the attack of September 11th 2001, the Afghani war, and the Iraqi war. Even though these events helped to shake the instability of the stock market and a collapse of investor confidence, but they were only secondary factors. A number of researches reported the reason for the crash is dated back to the 1980s, where the increase of the market stock price was not justified with the economic growth. There were factors that were not explained by the modern investments theories that forced these markets to surge. In year 1997, the Price/Earning ratio passed the record high of year 1929 and increased with another 33 percent in year 2000 (Baker 2000). During the period from 1992 to 2000 the markets and economy experienced a period of record expansion. The IPO market had new companies trading at over a one billion dollar market capitalization with no profits and less than one million dollars in revenue (Bull 2004). Investors recognized that the market was highly priced. Most people were puzzled over the apparent high levels of the stock market. Makin (2002) in a study was unsure whether the market levels made sense or whether it was a result of some human tendency that might be called 'irrational exuberance'. He concluded that unjustified optimism, an optimism that might pervade thinking and affected a lot of life decisions. England (2001) discussed the characteristics of the US securities industry markets in year 1999, which was virtually a record setting in every aspect. Stock volume, market performance, new capital raising, and merger and acquisition activity all set annual

records as Wall Street's longest bull market accompanied the United States longest economic expansion.

In explaining the factors that were behind the stock crash market, Stroh (2000) talked about unusual earnings. The cumulative P/E ratio of all domestic NASDAQ stocks hit unprecedented, frothy levels of 81.2. He added, it would require a decline of over 75 percent to stock price index to take back NASDAQ's P/E ratio to where it started at the beginning of the bull market. Bradford (2002) discussed the role of today's economy, which is unpredictable than ever due to deregulation, globalization, and the information technology revolution. These forces have eroded the ability of experts to make predictions and to cope with the pace or direction of the economic changes.

Nowadays, in the era of Internet Technology, it is clear that investors have access to large volume of information on the stock market. Most of that information explains technical issues of trading activities, which in most of the cases overlooks measures that highlight strength and weakness of stocks. These measures if introduced may lead investors to make better assessments. The purpose of this study is to explore the validity of the financial measures in predicting stocks riskiness during the market downturn of year 2008. The research problem is set in the following question, which is:

Are fundamental measures capable of identifying risky stocks during market downturns?

Research Methodology

The study takes a deep look into the factors that affect the financial market and tests the ability of financial measures in predicting stocks that could be adversely affected in a market downturn. The research studies the price movement of all firms listed on the National Association of Securities Dealers Automated Quotations (NASDAQ) market during the downturn of year 2008. It focuses on the ability of the financial measures to predict the stock price movements. Analysts, practitioners and academicians used financial ratios in assessing stock returns in financial markets (Arslan, O. and Baha, M., 2010; Bhandari 1988; Basu 1977; Tze, S., and Bon H., 2009). Irwin (2001) in a study used financial measures to test the financial structure of distressed firms.

Binary Logistic Regression Model (BLRM) is used to test the research problem. Logistic regression is superior to linear regression model where normality assumptions of the independent variables are not met. It is simpler to read and to interpret because its values are bound to range between zero and one (Tsun-Siou, Yin-Hua & Rong-Tze 2003).

The use of the logistic regression model in this study is to evaluate the predictive power of the Independent variables (fundamental measures) in classifying traded stocks into two groups (dependent variable). The dependent variable is non-metric measure and it is used to identify these two-stock groups; stocks that are adversely

affected during market downturn and they are assigned value = 0, and stocks that are less adversely affected and they are assigned value = 1.

Data used is a secondary type and is taken from Compustat. It is made of the 3,934 firms that are listed on NASDAQ stock exchange market. To capture the price movement during year 2008 downturn, data of these companies were taken from two time frames i.e. January 01, 2008 and December 31, 2008.

The research model aims at identifying two groups of stocks (dependent variable). The dependent variable is a non-metric one and reflects two types of price changes: 1- Risky group (coded 0) represents stocks that were adversely affected during the downturn of year 2008 i.e. stocks with a decline in price exceeding the 50%, which represents the average drop in prices during that period. 2- Less Risky group (coded 1) represents stocks that were less adversely affected the same period with a decline in price than that of the 50% average.

The independent variables are metric ones and are the financial measures of the firms. They belong to five categories; liquidity measures (Urbanic, 2005; Arslan and Baha, 2010), profitability and return measures (Bernstein and Wild, 1999; Arslan and Baha, 2010), asset management (Urbanic, 2005), financing measures (De Vaney, 1994) and market measures (Mukherji et al.1997).

In testing the reliability of the model, two measures are used.

1- Coefficient of Determination (R^2_{Logit}) is similar to that of the ordinary least squares (OLS) regression:

$$R^2_{\text{Logit}} = 1 - (2LL_0 / 2LL_1)^{1/2} \quad (1)$$

Where $-2LL_0$ is the log-likelihood (represents unexplained variations) of the model without the independent variables. $-2LL_1$ is the log-likelihood of the research model based on the independent variables that remained in the model and exhibited significant power in explaining the two stock groups. In general, the interpretation of R^2_{logit} is similar to the coefficient of determination R^2 in multiple regressions. It has a value that ranges between 0 and 1. When R^2_{logit} approaches 0, the model is poor. When R^2_{logit} approaches 1, the model is a perfect predictor.

2- Overall Hit Ratio: The normal Z-test for the binomial was performed to test the significance of the overall hit ratio (proportion of correctly classified cases). The following formula was applied:

$$Z\text{-test} = [P - 0.5] / [0.5 (1 - 0.5) / N]^{1/2} \quad (2)$$

Where P = hit ratio = proportion of correctly classified cases, N = sample size.

The Z-test tests the significance of the hit ratio from 0.5. The hit ratio measures the percentage of times the model accurately classified the cases into the two stock groups i.e. if the model completely explains the dependent variable, the overall hit ratio would be 100%. A level of significance of 5% is used.

Data Analysis

The testing was done using the forward method (SPSS); the most significant independent variable enters the model first, followed by those that are less significant to the limit of alpha of 5%. The number of cases removed from the model because of incomplete data was 3,148, while the number of cases that remained in the model was 786.

In stage1, the summary output (table 1) showed the following results:

Table 1- Variables in the Model: P/ BV (Stage 1)

Observed	Predicted		
	Financially		Percentage correct
	Safe - 1	Risky - 0	
Safe - 1	143	183	56.13%
Risky - 0	400	60	86.96%
Overall Hit Ratio			74.17%

The most significant measure was Price to Book Value ratio and was the 1st measure to enter the model; it explained correctly 56.13% of safe stocks, 86.96% of risky stocks, with an overall hit ratio of 74.17%.

In stage 2, the summary output (table 2) showed the following results:

Table 2- Variables in the Model: P/ BV and P/E (Stage 2)

Observed	Predicted		
	Financially		Percentage correct
	Safe - 1	Risky - 0	
Safe - 1	415	45	90.22%
Risky - 0	145	181	55.52%
Overall Hit Ratio			75.83%

Price to earnings ratio (P/E) exhibited significant power and entered the model along with P/ BV measure; they both correctly classified 90.22% of safe stocks, 55.52% of risky stocks, with an overall hit ratio of 75.83%.

In stage 3, the summary output (table 3) showed the following results:

Table 3: Variables in the Model: P/BV, P/E, and DSC(Stage 3)

Observed	Predicted		
	Financially		Percentage correct
	Safe	Risky	

Safe	415	45	90.22%
Risky	143	183	56.13%
Overall Hit Ratio			76.08%

Debt Service Coverage (DSC) ratio exhibited significant power and entered the model along with P/BV, and P/E ratios; they all correctly classified 90.22% of safe stocks, 56.13% of risky stocks, with an overall hit ratio of 76.08%.

Testing Reliability

In testing the reliability of the model, the following is summary output (Table 4) of the three -stage R^2_{logit}

Table 4- R^2_{logit} Results

Stage	Variables in the model	R^2_{Logit}	Remarks
1	P/BV	10.34%	Slightly significant
2	P/BV and P/E	11.56%	Slight Increase
3	P/BV, P/E, and DSC	12.26%	Slight Increase

2- Overall Hit Ratio: The following is the summary output (Table 5) of 3-stage overall hit significance test

Table 5- Significance of Overall Hit ratio of Measures

Measures	Hit Ratio %	N	Z computed	Critical Value	Result
P/BV	74.17	786	13.55	1.65	Significant
P/BV and P/E	75.83	786	14.48	1.65	Significant
P/BV, P/E, and DSC	76.08	786	14.62	1.65	Significant

Both measures showed that the model's reliability is significant.

Limitation of the study

There were three limitations in the study, which are the following: 1- Missing cases: 3,148 cases in this study had missing variables, which were removed from the study as reported in the analysis. 2- The external validity of the model was not tested. 3- Outliers were not removed from the study.

Conclusions

The research output showed that a group of financial measures i.e. Price / Book value, Price / Earnings, and Debt Service Charge exhibited significant effect in predicting the stock's riskiness; they correctly classified 76.08% of the cases with

R^2_{logit} of 12.26%. While on the other hand, based on a previous study done by Bahhouth et. al. (2010) on S&P 500 stocks, Beta showed significant power in predicting stock price movements by explaining 20% to the total variations and leaving 80% of unexplained. Both models failed to explain significantly the total variation in price movement during market down turn.

In view of the variability of the results, would it be logical for investors to use financial measures in assessing stocks' price movement? Results show that there is no common set of reliable measures that can be used to predict stock price movements during the market downturn of year 2008. Accordingly, it is recommended to conduct further studies to investigate the sources of the variability in the price movements.

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THE BUSINESS VALUE OF CLOUD COMPUTING

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ABSTRACT

Cloud computing is a technique for supplying computer facilities and providing access to software via the Internet. Cloud computing represents a contextual shift in how computers are provisioned and accessed. One of the defining characteristics of cloud software service is the transfer of control from the client domain to the service provider. Another is that the client benefits from economy of scale on the part of the provider. Cloud computing is particularly attractive to small and medium-sized organizations, because it represents a lower total cost of ownership (TCO) than alternative modalities.

INTRODUCTION

As modern business, government, and education have evolved into the 21st century, the use of computers to sustain everyday operations has increased. Most organizations employ computers to enhance core services and provide supplementary services to gain efficacy and efficiency for auxiliary operations. One of the newest technologies for IT provisioning is cloud computing that has garnered a considerable amount of attention in the business, education, and government communities. Many persons in small business and universities are not totally aware of the benefits of cloud computing, and that is the reason for this paper. First, we will cover what cloud computing is; then we will cover how it works; next we will cover how to get it; and finally, we will take a good shot at giving the pros and cons of adopting it as your mode of operation.

Cloud computing is a means of providing computer facilities via the Internet, but that is only half of the picture. The other half is that it is also a means of accessing those same computer facilities via the Internet from different locations. When a large bank, for example, moves to cloud computing for online operations, it necessarily considers both halves of the equation. The adjective “cloud” reflects the diagrammatic use of a cloud as a metaphor for the Internet. In telecommunications, a *cloud* is the unpredictable part of a network through which business and personal information passes from end-to-end and over which we do not have direct knowledge or control.¹

The value proposition that underlies cloud computing is that an organization does not have to pay the upfront costs of hardware, software, networks, people, training, and other infrastructural elements. Instead, the organization would utilize resources provided on the Internet as they would a service utility, such as electric service and pay only for what it uses. The service would take care of peak periods, support, downtime, training, and a myriad of other things with which an organization would possibly prefer not to get involved. Another important consideration is that many organizations that depend on online services have to plan for a worst-case scenario and experience low server utilization even during peak periods. Some major banks have a server use percentage as low as 6% during normal periods and 20% during peak periods.

The essence of cloud computing is service. The company providing cloud computing service assumes the role of service provider, and the organization using the service takes on the role of the client (or customer) with all of the rights and privileges pertaining thereto. Services are indigenous to the existence of modern society and are constantly being invented and retired. So we should be right at home with cloud compu-

¹ See *Privacy in the Clouds* by Cavoukin for more information on this subject.

ting. At least, that is what major computer and software companies, major financial organizations, the U.S. Government, and the National Institute of Standards and Technology (NIST) seem to think.²

CHARACTERISTICS OF CLOUD COMPUTING

Computing is a social phenomena based on technology, the basis of which is input, processing, output, and storage. If the task is an ordinary computer application, such as word processing, payroll, use of the cell phone, or checkout at the supermarket, there is always the aforementioned four steps known as the *information processing cycle*. In a very general sense, input can come from people and machines, processing is done by computers, output goes to people or machines, and information produced or absorbed during computation can be stored for future use on electronic devices. Where in an organizational sense each of the steps actually takes place determines if it is cloud computing or traditional “on premises” computing. Relying on evolutionary processes, we can observe that the structure of an organism essentially determines its potential for growth. So it is with cloud computing.

A cloud computing service would necessarily have ubiquitous access through a Web browser or mobile device providing the input step. The computing and storage facilities would reside in and operate from a data center in the cloud. The output is returned to the end user through the browser program or mobile device, mentioned previously. In order to sustain the cloud operational environment, a cloud computing service would provide a utility-level infrastructure with the following operational characteristics: necessity, reliability, usability, and scalability. *Necessity* refers to the idea that a preponderance of users depend on the service to satisfy everyday needs. *Reliability* refers to the expectation that the service will be available when the user requires it. *Usability* refers to the requirement that the service is easy and convenient to use – regardless of the complexity of the underlying infrastructure. *Scalability* refers to the fact that the service has sufficient capacity to allow the users to experience the benefits of an expandable service that provides economy of scale. Certainly, modern Internet facilities for search operations that typically engage thousands of servers satisfy these characteristics.

APPLICATION SERVICE PROVISIONING

The need for effective computer service provisioning has been on the sidelines for some time and represents a unrealized requirement in the business, education, and government worlds. The situation is that small to medium-sized organizations have need for expensive computing facilities and software service. A prototypical example is the small software firm that needs occasional mainframe computer time. The solution has been to lease service from an application service provider (ASP) and use that service via network facilities. The ASP supplies the computer time and provides operational software as required. The process is known as *hosting*. The customer assumes the network expenses without the up-front hardware, software, and facilities costs.

With cloud computing, the Internet provides the network facilities. A cloud service provider supplies the computer and operating system resources that can be accessed via the Internet. Applications software is supplied by an independent software vendor (ISV) and therein resides the benefit to the customer. The customer, which can have several users, shares the software among several customers so as to achieve significant economy-of-scale.

BUSINESS AND CONSUMER SERVICE

Chong and Carraro at Microsoft³ define shared software as *software-as-a-service* (SaaS) deployed as a hosted service and accessed over the Internet. The key features of SaaS are where the programs reside

² See the NIST definition of cloud computing by Mell and Grance.

and how they are accessed. The two kinds of software in this category are business software and consumer software. Business software provides business services and emphasizes business solutions, such as customer relationship management (CRM), supply chain management (SCM), enterprise resource planning (ERP), and human resources. Consumer software provides personal solutions, such as office applications, that are often available at no cost in their cloud versions.

With business services, the most important consideration is whether the process is executed in-house or as a cloud service. When the process is handled in-house, total control over the operation is obtained along with limited opportunity for achieving economy-of-scale. As processes are distributed outward on the cloud, control is decreased but opportunities for achieving economy-of-scale are increased. The considerations are different with consumer services. Pure service, as with office applications, provides practically no control over the application to the client and a reasonably high-level of economy-of-scale to the provider. In many cases, consumer services are advertising-supported and are complimentary to the client through advertising. In addition to metered and subscription models, the advertising-supported model is another means of monetizing cloud computing.

Business applications that reside “on premises” are governed by the traditional considerations of application acquisition and deployment. If an application resides on and is deployed from the cloud, then two options exist:

- (1) Build the software yourself (or have it built for you) and run it on the cloud as a hosted service – perhaps using a cloud platform.
- (2) Obtain the application software from an independent software vendor (ISV) and run it on the cloud in a standard or modified mode.

In the former case, all users access the same version of the software. In the latter case, a client gets a customized version achieved with a separate code base (or its equivalent) and configuration options. A note on terminology is in order, especially with regard to line-of-business software. In a prototypical cloud environment, there are multiple service entities providing service, such as the cloud infrastructure provider (i.e., the computer part) and the ISV (i.e., the software part).

The two entities are combined for discussion purposes into a single service provider that we are going to conceptually refer to as the cloud software service (CSS). Two companies, for example, contract with the CSS for access to and the execution of business applications in areas such as general ledger, treasury management, real estate, and so forth. The companies are referred to as customers of the CSS. Each customer entrusts several employees to use the contracted services, and they are regarded as the users. In some instances, the customers and their respective users are considered to be clients of the service provider³

The primary advantage of a cloud consumer service is that it is typically free to the client, as well as being accessible from any location via the Internet, and it yields advertising-supported revenue for the provider. Consumer services have a near-zero marginal cost of distribution to clients, requiring only a fraction of the number of clients to respond to advertising. This is the well-known *Freemium Business Model*⁴, characterized as follows: In the free sample product model, you give away 1% of your product to sell the additional 99%, whereas in the freemium model, you give away 99% to sell 1%.⁵ Because of the scale of the Internet with millions of users, you can reach a large market, so that the 1% is a huge amount.

³ See Chong, 2006.

⁴ See Anderson 2006.

⁵ The percentages should not be taken literally, in this instance. They are used only to make a point (Anderson 2006).

Clearly, the business model for the deployment of SaaS changes with the adoption of cloud computing. The ownership of software shifts from the client to the provider, along with the responsibility for the technology infrastructure and its management⁶.

CLLOUD PLATFORMS AND SERVICE DEPLOYMENT MODELS

A *cloud platform* is an operating system that runs in the cloud and supports the software-as-a service concept. A cloud platform resides in a cloud data center and exists as a powerful computing facility, a storage system, an advanced operating system, support software, and the necessary fabric to sustain a server farm and scale up to support millions of Internet clients. A cloud platform is as much about operating in the cloud, as it is about developing applications for the cloud. A cloud platform provides the facility for an application developer to create applications that run in the cloud; and, in so doing, the application developer uses services that are available from the cloud. Cloud platforms are a lot like enterprise-level platforms, except that they are designed to scale up to Internet-level operations supporting millions of clients.

The essential elements of a cloud service deployment are given above. In order to develop enterprise-wide applications, a comprehensive viewpoint has to be assumed with deployment models from the following list: (Mel op cit.)

Private cloud. The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off-premise.

Community cloud. The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be managed by the organizations or a third party and may exist on-premises or off-premises.

Public cloud. The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.

Hybrid cloud. The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds).

Many cloud software service application domains will be synthesized from a combination of the deployment models.

CLLOUD SERVICE ECONOMICS

Cloud services mark a milestone in IT service provisioning. The cloud model promotes availability and operates through a large ecosystem of different approaches to on-demand accessibility supplied by vendors and various market niches. The pool of shared resources essentially determines the economics of the cloud paradigm.

Cloud service democratization refers to either of three distinct but related forms. In the first instance, known as the availability model, it is the process of making a premium cloud service available for general use, rather than through proprietary services. In the second instance, known as the sharing model, it is the capability of sharing data, infrastructure, and storage that would not be otherwise accessible with on-premises facilities. The final instance, known as the voting model, is the phenomena of giving power to

⁶ See Chong 2006.

the end user by providing access to facilities that are implicitly more preferable than other cloud resources by virtue of the fact that they are used or referenced more frequently by other end users.

The *availability model* reflects the ability of having access to information, software, and computing resource infrastructure without necessarily having to own it. In many cases, the cost and time elements are too high for many organizations, because the up-front costs and time to develop the information, software, and on-premises resources is simply too great for many potential clients and ISVs. The cost of providing computing infrastructure and software by traditional ISVs is such that it is affordable only by larger businesses. This situation leaves out the long tail of small to medium-sized businesses that could benefit from the solution, if the cost were lower. By lowering the cost of service provisioning by utilizing multi-tenancy technology and taking advantage of economy of scale achieved through multiple clients from the cloud, business software services are available to the long-tail market.

The *sharing model* refers to the fact that three major classes of technical resources are available, on a shared basis, through the cloud platforms: data and information, infrastructure services, and data storage facilities. In the case of *data and information*, content can be shared between users from the same client, between clients, and between platforms from the same user. Effectively, more information is available to more users. *Infrastructure sharing* is a major category of cloud service and is a major cost to an IT shop. It includes software, hardware, and security services. With software, comprehensive facilities are available at a lower price, because the cost is shared among thousands of users. With hardware, the end user does not need to plan for peak periods and growth, since elasticity is designed into the architecture of cloud platforms. This is the “scalability” characteristic of utility services. For security, federated security systems are shared among users and clients enabling mobility between diverse computing platforms. *Data storage sharing* refers to the common habitation of data on a cloud platform by several clients. Storage multiplicity, commonly available on cloud platforms, reduces organizational concerns in the general area of disaster planning.

The value of certain services, such as web auctions (e.g., e-Bay), user-supported encyclopedias (e.g., Wiki), and modern search engines (e.g., Google), is derived from the fact that many people use them. This is known as the *voting model*. The power of such facilities lies in the fact that each individual user votes by choosing to use the respective service. With a web auction, it is the interchange between users that gives the facility its democratic power. With an updatable online encyclopedia, an individual end user has the power of updating an entry. This option allows the informational resource to evolve as more people use it. With a search engine, such as Google, it is the method of page ranking, wherein the number of page references to an object page gives its score, and allows a universe of users to democratize a page. Collectively, cloud service democratization essentially enables the delivery of computing service to more clients at a reduced cost.

The basis for the monetization of cloud computing is software-as-a-service (SaaS), commonly regarded as software hosted service from a cloud platform. The varieties of software-as-a-service are non-configurable, single-tenant, and multi-tenant. With *non-configurable SaaS*, the service provider delivers a unique set of features that are hosted in the cloud through a cloud platform and Internet accessibility to the client. With *single-tenant SaaS*, the client has isolated access to a common set of features, perhaps configured in a distinctive way. With *multi-tenant SaaS*, the provider hosts common program logic and unique data elements for multiple clients on scalable infrastructure resources supported via a cloud platform.

BUSINESS AND SERVICE MODELS

The salient features of the cloud computing business model are summarized as follows:

- The ownership of the software is transferred to the cloud service provider.
- The responsibility for hardware, application software, storage facilities, and professional services resides with the provider.
- Systems software is available from a trusted vendor for supporting cloud services.
- Data centers are available for sustaining the operational structure and supporting the requisite fabric needed to utilize server farms.

Accordingly, the business model provides the economy of scale needed to target the long tail by providers and reduces up-front and operational costs for the client.

The SaaS provider with cloud computing will characteristically experience high up-front costs for infrastructure and software development. The SaaS client will have to give up a certain level of control to benefit from the economy-of-scale supplied by the provider. There are lingering questions over “who owns the software,” “who owns the data,” and information security.

The cloud service models give an ontological view of what a cloud service is. A cloud service system is a set of elements that facilitate the development of cloud applications. Here is a description of the three layers in the NIST service model description: (Mel op cit.)

Cloud Software as a Service (SaaS). The capability provided to the consumer is the use of the provider’s applications running on a cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a web browser (e.g., web-based email). The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

Cloud Platform as a Service (PaaS). The capability provided to the consumer is that of deploying onto the cloud infrastructure consumer-created or acquired applications developed through the use of programming languages and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations.

Cloud Infrastructure as a Service (IaaS). The capability provided to the consumer is the capability of provisioning processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over the operating system, storage, and deployed applications, as well as limited control over selected networking components (e.g., host firewalls).

The three service model elements should be deployed in a cloud environment with the essential characteristics in order to achieve a cloud status

QUICK SUMMARY

1. Cloud computing is a means of accessing computer facilities via the Internet. (The *cloud* is a metaphor for the Internet.)
2. Cloud service facilities are characterized by four key factors: necessity, reliability, usability, and scalability.
3. Software-as-a-service (SaaS) is software deployed as a hosted service and accessed over the Internet.
4. For the cloud client, business service is a balance between control and economy of scale.

5. A cloud platform is based on an operating system that runs in the cloud and provides an infrastructure for software development and deployment.
6. Cloud service *democratization* refers to information and computing availability, information sharing, and the exercise of user preference in supplying information service.
7. Cloud service *monetization* refers to gaining financial benefit through cloud access and economy-of-scale for both provider and client.

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IDENTITY AS A SERVICE

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ABSTRACT

Identity is an important subject in information systems in general and cloud computing in particular. Normally associated with digital security and privacy, the scope of identity is much greater and affects related subjects such as behavioral tracking, personal-identifiable information (PII), privacy data relevance, data repurposing, and identity theft. Cloud computing is currently portrayed as a model for providing on-demand access to computing service via the Internet and also serves as a focus for modern security and privacy concerns. This paper is an admixture of the major issues in the privacy and security of individual rights in a complex informational environment.

INTRODUCTION

Identity is a major issue in the security of modern information systems and the privacy of data stored in those systems. Security and privacy concerns are commonly associated with behavioral tracking, personal-identifiable information (PII), the relevance of private data, data repurposing, and identity theft. We are going to approach the subject from a cloud computing perspective, recognizing that the inherent problems apply to information systems, in general. Cloud computing is a good delivery vehicle for underlying security and privacy concepts, because data is typically stored off-premises and is under the control of a third-party service provider. When a third party gets your data, who knows what is going to happen to it? The main consideration may turn out to be a matter of control, because from an organizational perspective, control over information has historically been with the organization that creates or maintains it. From a personal perspective, on the other hand, a person should have the wherewithal to control their identity and the release of information about themselves, and in the latter case, a precise determination of to whom it is released and for what reason. Privacy issues are not fundamentally caused by technology, but they are exacerbated by employing the technology for economic benefit. After a brief review of cloud computing, security, and privacy to set the stage, we are going to cover identity theory, identity requirements, and an identity taxonomy. This is a working paper on this important subject.

Cloud Computing Concepts for Identity Services

Cloud computing is an architectural model for deploying and accessing computer facilities via the Internet. A cloud service provider would supply ubiquitous access through a web browser to software services executed in a cloud data center. The software would satisfy consumer and business needs. Because software availability plays a major role in cloud computing, the subject is often referred to as *software-as-a-service* (SaaS). Conceptually, there is nothing particularly special about a cloud data center, because it is a conventional web site that provides computing and storage facilities. The definitive aspect of a cloud data center is the level of sophistication of hardware and software needed to scale up to serve a large number of customers. Cloud computing is a form of service provisioning where the service provider supplies the network access, security, application software, processing capability, and data storage from a data center and operates that center as a utility in order to supply on-demand self service, broad network access, resource pooling, rapid application acquisition, and measured service. The notion of measured service represents a “pay for what you use” metered model applied to differing forms of customer service.

The operational environment for cloud computing supports three categories of informational resources for achieving agility, availability, collaboration, and elasticity in the deployment and use of cloud services

that include software, information, and cloud infrastructure. The *software category* includes system software, application software, infrastructure software, and accessibility software. The *information category* refers to large collections of data and the requisite database and management facilities needed for efficient and secure storage utilization. The *category of cloud infrastructure* is comprised of computer resources, network facilities, and the fabric for scalable consumer operations.

Based on this brief description, we can characterize cloud computing as possessing the following characteristics: on-demand self service, broad network access, resource pooling, rapid elasticity, and measured service. (Nelson 2009) The benefit of having lower costs and a less complex operating environment is particularly attractive to small-to-medium-sized enterprises, certain governmental agencies, research organizations, and many countries. In this paper, cloud computing is used as a delivery vehicle for the presentation of identity services.

Information Security and Identity

The scope of information security is huge by any objective measure. One ordinarily thinks of information security in terms of identity, authentication, authorization, accountability, and end-to-end trust.

Identity is a means of denoting an entity in a particular namespace and is the basis of security and privacy – regardless if the context is digital identification or non-digital identification. We are going to refer to an identity object as a *subject*. A subject may have several identities and belong to more than one namespace. A pure identity denotation is independent of a specific context, and a federated identity reflects a process that is shared between identity management systems. When one identity management system accepts the certification of another, a phenomenon known as “trust” is established. The execution of trust is often facilitated by a third party that is acknowledged by both parties and serves as the basis of digital identity in cloud and other computer services.

Access to informational facilities is achieved through a process known as *authentication*, whereby a subject makes a claim to its identity by presenting an identity symbol for verification and control. Authentication is usually paired with a related specification known as authorization to obtain the right to address a given service.

Typically, *authorization* refers to permission to perform certain actions. Users are assigned roles that must match corresponding roles associated with a requisite computer application. Each application contains a set of roles pertinent to the corresponding business function. Access is further controlled by business rules that specify conditions that must be met before access is granted. The role/business-rule modality also applies to information storage, and this is where the practice of privacy comes into consideration.

In general, the combination of identification and authentication determines who can sign-on to a system – that is, who is authorized to use that system. Authorization, often established with access control lists, determines what functions a user can perform. Authorization cannot occur without authentication. There are two basic forms of access control: discretionary access control, and mandatory access control. With discretionary access control (DAC), the security policy is determined by the owner of the security object. With mandatory access control (MAC), the security policy is governed by the system that contains the security object. Privacy policy should, in general, be governed by both forms of access control. DAC reflects owner considerations, and MAC governs inter-system controls.

Accountability records a user’s actions and is determined by audit trails and user logs that are prototypically used to uncover security violations and analyze security incidents. In the modern world of computer and information privacy, accountability would additionally incorporate the recording of privacy

touch points to assist in managing privacy concerns over a domain of interest. Although the Internet is a fruitful technology, it garners very little trust, because it is very cumbersome to assign responsibility for shortcomings and failure in an Internet operational environment. Failure now takes on an additional meaning. In addition to operational failure, it is important to also include "inability to perform as expected," as an additional dimension.

Trustworthy computing refers to the notion that people in particular and society as a whole trust computers to safeguard things that are important to them. Medical and financial information are cases in point. Computing devices, software services, and reliable networks are becoming pervasive in everyday life, but the lingering doubt remains over whether or not we can trust them. Expectations have risen with regard to technology such that those expectations now encompass safety, reliability, and the integrity of organizations that supply the technology. Society will only accept a technological advance when an efficient and effective set of policies, engineering processes, business practices, and enforceable regulations are in place. We are searching for a framework to guide the way to efficacy in computing.

It is generally felt that a framework for understanding a technology should reflect the underlying concepts required for its development and subsequent acceptance as an operational modality. A technology should enable the delivery of value rather than constrain it, and that is our objective with identity service

Privacy Concepts

Information systems typically process and store information about which privacy is of paramount concern. The main issue is identity, which serves as the basis of privacy or lack of it, and undermines the trust of individuals and organizations in other information-handling entities. The key consideration may turn out to be the integrity that organizations display when handling personal information and how accountable they are about their information practices. From an organizational perspective, control over information should remain with the end user or the data's creator with adequate controls over repurposing. From a personal perspective, the person should have the wherewithal to control his or her identity as well as the release of socially sensitive identity attributes. One of the beneficial aspects of the present concern over information privacy is that it places the person about whom data are recorded in proper perspective. Whereas such a person may be the object in an information system, he or she is regarded as the subject in privacy protection – as mentioned earlier. This usage of the word *subject* is intended to imply that a person should, in fact, have some control over the storage of personal information.

More specifically, the *subject* is the person, natural or legal, about whom data is stored. The *beneficial user* is the organization or individual for whom processing is performed, and the *agency* is the computing system in which the processing is performed and information is stored. In many cases, the beneficial user and the subject are members of the same organization.

The heart of the issue is *privacy protection*, which normally refers to the protection of rights of individuals. While the concept may also apply to groups of individuals, the individual aspect of the issue is that which raises questions of privacy and liberty

Privacy Assessment

The Federal Bureau of Investigation (U.S.A.) lists several criteria for evaluating privacy concerns for individuals and for designing cloud computing applications: (FBI 2004)

- *What information is being collected?*
- *Why is the information being collected?*

- *What is the intended use of the information?*
- *With whom will the information be shared?*
- *What opportunities will individuals have to decline to provide information or to consent to particular uses of the information?*
- *How will the information be secure?*
- *Is this a system of records?*

Since privacy is a fundamental right in the United States, the above considerations obviously resulted from extant concerns by individuals and privacy rights groups. In a 2009 Legislative Primer, the following concerns are expressed by the Center for Digital Democracy: (CDD 2009, p. 2)

- Tracking people's every move online is an invasion of privacy.
- Online behavioral tracking and targeting can be used to take advantage of vulnerable consumers.
- Online behavioral tracking and targeting can be used to unfairly discriminate against consumers.
- Online behavioral profiles may be used for purposes beyond commercial purposes.

We are going to add to the list that the very fact that personal data is stored online is a matter of concern and should be given serious attention. Based on these issues, this paper is going to take a comprehensive look at the subject of identity in computer and human systems.

IDENTITY THEORY

The notion of identity is an important subject in philosophy, mathematics, and computer information systems. In its most general sense, identity refers to the set of characteristics that makes a subject definable. Each characteristic can be viewed as a single point in a three-dimensional Cartesian coordinate system where the axis are *subject*, *attribute*, and *value*. (Katzan 1975) Thus, the fact that George is twenty-five years old could be denoted by the triple <George, age, 25>. A set of characteristics over a given domain can uniquely identify a subject. This simple concept is the basis of privacy and identity in cloud computing, information systems, and everyday life. The notion of identity applies to organizational subjects as well as to person subjects.

Knowledge and Power

The phrase "knowledge is power" is a popular means of expressing the value of information. So popular, in fact, that one would think its origin is the modern age of computers and information technology. That assumption, however, is not correct. The first reference that could be found is credited to the famous Sir Francis Bacon in his book published in 1605 entitled *Advancement of Learning*, quoted as follows: (Bacon 1605)

But yet the commandment of knowledge is yet higher than the commandment over the will: for it is a commandment over the reason, belief, and understanding of man, which is the highest part of the mind, and giveth law to the will itself. For there is no power on earth which setteth up a throne or chair of estate in the spirits and souls of men, and in their cogitations, imaginations, opinions, and beliefs, but knowledge and learning.

Knowledge, in the sense that it is information concerning a thing or a person, can be used to further one's endeavors or it can be used to control a subject, thus diminishing its freedom and liberty. The protection

of personal privacy is a Fourth Amendment right, and identity is the basis of privacy. The following sections give a philosophical view of identity.

Knowledge, Attributes, and Identity

Identity is primarily used to establish a relationship between an attribute or set of attributes and a person, object, event, concept, or theory. The relationship can be direct, based on physical evidence, and in other cases, the relationship is indirect and based on a reference to other entities. In a similar vein, the relationship can be certain or uncertain, and in the latter case, based in deduction or inference. The relationship determines an element of knowledge. For example, the knowledge element “you are in your car” is a statement in which “you” and “your car” are things that exist and the “in” is a relationship. Direct knowledge is known by *acquaintance* and is evidenced by a physical connection. Indirect knowledge is determined through a reference to a particular with which the analyst is acquainted. The form is known as knowledge by *description*. (Russell 1912) *Direct knowledge* is determined through sense data, memory, or introspection. *Indirect knowledge* is determined through a reference to another particular, as in “the person who ran for congress in 2004” or through a form of self-awareness where what goes on in subject’s mind, for example, is estimated by an analyst’s interpretation based on experience or self-evaluation.

Synthetic knowledge reflects certainty based on evidence inherent in the attribute values at hand. *Analytic knowledge* reflects a degree of uncertainty and is determined by deduction, as in “he is the only person with that ‘attribute value’,” or by inference based on known particulars, such as “all terrorists have beards.” Inference, in this case, could be regarded as a form of derivative knowledge. The value of analytic knowledge is that it enables the analyst to exceed his or her limit of private experience. (Kant 1787)

Numerical and Qualitative Identity

Identity refers to the characteristics that make a subject the same or different. We are going to establish two forms of identity: numerical and qualitative. Two subjects are *numerically identical* if they are the same entity, such that there is only one instance. Two subject (or objects in this case) are *qualitatively identical* if they are copies or duplicates. In the popular movie *The Bourne Identity*, for example, the characters *Jason Bourne* and *David Web* are numerically identical, and the number of subjects is one. So it is with *Superman* and *Clark Kent* in another domain. On the other hand, a set of animals with the same biological characteristics – e.g., a species – are regarded as being qualitatively identical. The notion of qualitative identity is remarkably similar to the modern definition of a *category* informally defined as a collection of entities with the same characteristics, having the same values for the same attributes.

Theory of the Indiscernibles

An important aspect of identity theory is that subjects exhibit features of permanence and change, analogous to sameness and difference mentioned previously. We are going to discuss the concept of temporal identity in the next section. The notion of change implies a subject that undergoes a transformation and also a property that remains unchanged. Both Locke and Hume¹ have proclaimed that change reflects the idea of unity and not of identity. Leibnitz proposed the *Theory of Indiscernibles* suggesting that subjects (i.e., objects or entities) that are indiscernible are identical. (Stroll 1967) The subject of indiscernibles has implications for cloud computing, information systems, and change. To

¹ Locke (*An Essay concerning Human Understanding*, Book II, Chapter 27) and Hume (*A Treatise of Human Nature*, Book I, Part IV).

what extent a change in a characteristic denotes a change in identity is an open item at this time and implies that there is a probabilistic aspect to identity.

Russell approaches the subject of identity from an alternate viewpoint, analogous to definite and indefinite articles. Russell proposes that a description may be of two sorts: definite and indefinite. A definite description is a name, and an indefinite description is a collection of objects x that have the property ϕ , such that the proposition ϕx is true. (Russell 1919) In the phrase *Dan Brown is a famous author*, for example, ‘Dan Brown’ is a name and the indefinite description is obvious, leading to the probabilistic link between a subject and a characteristic.

Temporal Identity

There is a rich quantity of philosophical literature on the change of identity over time. Are you the same person you were yesterday? Are there persistent attributes that allow for positive identity between time periods? As alluded to previously, entities in everyday life exhibit features of permanence and change. In the domain of personal identity, address attribute is a primary candidate for change. For example, John Smith lives at 123 Main Street. He moves out and another John Smith moves in. This is distinct possibility in a crowded city. In there a concept in identity theory for this phenomena? Should an identity system take this eventuality into consideration?

There is a form of *attribute duality* between a person subject and an object subject. A subject – an object, such as a residence, in this case – is characterized by who lives there. For example, rich people live on Sutton Place in New York. The discussion leads to four related concepts: *endurant identity*, *perdurant identity*, *endurant attribute*, and *perdurant attribute*. Clearly, the term *endurant* refers to a noun that does not change, where *perdurant* refers to one that does. Thus, the identity problem is essentially translated to an operant problem of “recognizing identity.”

IDENTITY PRINCIPLES

It would appear that there are two essential problems in identity theory: protection of identity and recognition of identity. Protection refers to the safeguarding of one’s identity from unwanted intrusion into personal affairs. Recognition refers to the use of identity measures to detect wanted persons. This characterization of the identity problem reflects two sides of the same sword

It is generally regarded that effective identity governance should be based on a set of principles to guide the professional activities of IT managers, security officers, privacy officers, and risk management. (Salido 2010, OECD 2010) As delineated, the principles would be based on efficacy in governance, risk management, and compliance with the following objectives:

Governance. Assurance that the organization focuses on basic issues and who is responsible for actions and outcomes.

Risk Management. Assurance that procedures are in place for identifying, analyzing, evaluating, remedying, and monitoring risk.

Compliance. Assurance that actions are within the scope of social and legal provisions.

In accordance with the stated objectives, we can delineate the eight core principles of effective and efficient identity management. (OECD op cit., p.3)

Principle #1. Collection Limitation Principle – there should be prudent limits on the collection of personal data with the knowledge or consent of the subject.

- Principle #2. Data Quality Principle – personal data should be relevant to stated purposes and be accurate, complete, and up-to-date.
- Principle #3. Purpose Specification Principle – the purpose of the data collection should be specified beforehand.
- Principle #4. Use Limitation Principle – data should be used only for the use specified and not be repurposed.
- Principle #5. Security Safeguards Principle – personal data should be safeguarded by reasonable and state-of-the-art security facilities.
- Principle #6. Openness Principle – the technical infrastructure for protecting personal data should be open as to development, practices, and policies.
- Principle #7. Individual Participation Principle – the subject should have the right to definitive information concerning the personal data collected, methods used, and safeguards employed and have the right to challenge the procedures employed.
- Principle #8. Accountability Principle – social, business, educational, and governmental data controllers should be required by legal or regulatory means to abide by principles 1-8 and be accountable for violations of their provisions.

The eight principles of identity agree in part and parcel to Cavoukian's "7 Laws of Identity, listed as follows without unneeded detail: (Cavoukian 2010) Personal control and consent; Minimal disclosure for limited use; "Need to know access;" User-directed identity; Universal monitoring of the use of identification technology; Human understanding and involvement; and Consistent access and interface to personal data.

Cloud computing hasn't caused the identity problem, but it clearly has exacerbated it, because of limitless flexibility, Internet service provisioning, enhanced collaboration, portability, and easy access. Some of the features that support identity protection are multiple and partial identities, single sign-on, third-part trust relationships, and audit tools that can be used by individuals.

Clearly, there are aspects of cloud computing that need to be addressed, and they are topics for further study.

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Social Networks: A Pilot Study

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ABSTRACT

This paper reports preliminary results from a pilot study about the use of social networks and the type of information posted by the user on his or her social networking web site. It probes the awareness of the user of the implications and possible impact of posted material in the employment process. The paper also reports the frequency of visits per day by the user to his or her social network web site.

INTRODUCTION

Social networking, one form of social media, is permeating the lives of individuals at an increasing rate. Facebook alone has about 350,000,000 registered users (Zuckerbury, 2009). Other high profile site are MySpace with 130,000,000 users, Twitter with 75,000,000 users, and LinkedIn with 60,000,000 users (Wikipedia,2010). Furthermore, the utilization of social networks has begun to permeate corporations, educational institutions, government, and even the medical community (Kornblum &Marklein, 2006; Larrumbide, 2009; Luo, 2007).

The connections that people make through social networks cannot be ignored nor underestimated. Powerful influence can be instantly exerted. Insight into people's thinking can be quickly assessed through social networks. One area that can benefit from such information is politics. Candidates for political office can and do use social networks to connect with people and to influence and to court them for their votes. Another area that benefits from social networking is marketing. Profiling of individuals from social networking information allows demographic segmentation for targeted advertising. A third area in which social networking information is being increasingly used is in the human resources hiring process and in monitoring current employees. A person's social networking site can either provide a positive or negative image of him or her. For example, inappropriate photos, language, and/or behavior are a few things that reflect poorly upon a job candidate.

This pilot study gathers information about various areas related to social networking site usage. Specifically, the type of information that people post on their social networking site, their reading of the privacy policy of the site, and their awareness of an employer's use of information on their social networking site are several areas that are included.

RESEARCH METHOD

Data was collected from a convenience sample of college juniors and seniors in a management principles course. All data was collected on an anonymous and voluntary basis. Subjects were asked questions about their use of social networks and the items they display on their personal social networking web pages. Also included were questions relating to privacy policies and employer usage of information on their social networking web site.

RESULTS & DISCUSSION

The demographic profile by age of the convenience sample for this study was 94% in the 18-25 year old range. By gender the profile was 58% female and 42% male. College seniors composed 58% of the sample and college juniors were 42%. There were 50 subjects in this pilot sample. Of these, 90% had personal social networking web sites. The other 6% without sites gave reasons such as no time, “consider it to be beneath me,” “too busy and not worth the time,” and “too much drama.”

By far, most subjects at 96% of the sample had their social networking web site on Facebook. MySpace came next at 62.2% of users on their site. Then Windows Live Spaces and Imeem followed with 6.67% of users each. Tagged had 4.44% of users, followed by Classmates and Twitter each at 2.22% of users. Clearly Facebook and MySpace were the most popular sites.

When asked how often the subject visited his or her social networking web site during the day, a wide range of responses occurred. The span went from less than once a day to twenty times a day. The four most frequent responses were once a day for 20% of users, twice a day for 6.7%, two to three times a day for 8.9%, and three times a day for 17.8%.

When asked what items the person posted on his or her social networking web site, a long list resulted. The most frequently responded items are contained in Table 1 and the least frequently mentioned items are in Table 2.

TABLE 1: MOST FREQUENTLY INCLUDED ITEMS ON SOCIAL NETWORKING WEB SITES

Items	Percentage
Your Picture	97.8 %
Gender	95.6 %
University	95.6 %
Real Name	82.2 %
Age	77.8 %
State	75.5 %
E-mail	71.1 %
Marital Status	68.9 %
Hobbies	68.9 %

TABLE 2: LEAST FREQUENTLY INCLUDED ITEMS ON SOCIAL NETWORKING WEB SITES

Items	Percentage
Favorite TV Shows	51.1 %
Lifestyle	40.0 %
Sports	37.8 %
Community Affiliations	24.4 %
Personality Type	15.6 %
Food Likes	15.5 %
Phone Number and/or Pseudonym	11.1 %
Eye Color	6.7 %
Street Address	4.44 %

When asked if their social networking web site was password protected 100% of those with a site responded that it was. However, only 66% of them were aware that their personal information could be read on the server and used in accordance with the privacy policy of the web site. When asked if they had read the privacy policy of the social networking web site on which they had their personal pages, 60% of respondents answered in the negative.

Use of social networking site information by employers in their decision process for hiring was another question asked. In response, 84% indicated that they did not think that current or future employers may use this information in their hiring process. Clearly this shows that the majority of users are either not informed or have misconceptions about use of their information. And because of the longevity of information gathered in digital format, the impact of damaging information for hiring purposes can have a lasting effect.

CONCLUSION

This pilot study begins to document some of the issues regarding information given by users in establishing a social networking web site. Indications so far confirm that much personal information is freely given by users without understanding of the use of that information by the web site or others. In fact, the site's privacy policy is not even read by the majority of users. The expansion of this research project and similar research by others into this ever-popular mode of communication is essential in order to educate those who use social networking sites.

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Workshop on Electronic Healthcare Information Exchange: Teaching and Research Implications

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DESCRIPTION

The nature of healthcare is evolving due to the push to adopt electronic health records. Because the technology is new, there is a critical need to understand the issues surrounding the adoption and use of electronic health records. The goal of electronic health records is to allow the sharing of health information between providers at the point-of-care. This sharing of information between the electronic health record systems at various healthcare providers is called health information exchange (HIE). The U.S. federal government aims to have providers exchanging health information at the state level as well as at the national level. Therefore, there are many stakeholders who need to coordinate efforts to exchange health information. These stakeholders include patients/consumers, providers, insurance companies, pharmacies, marketing organizations, patient advocacy groups, policy-makers and legislators, educational institutions, and research organizations. Because there are many stakeholders involved, the implementation of healthcare information exchange technology is very complicated.

\$2 billion of federal funds has been dedicated to the adoption of healthcare information exchange technology, with the U.S. Department of Health and Human Services (DHHS) recently allotting \$162 million for State Health Information Exchange Cooperative Agreement Programs (Manos, May 2010). The DHHS awarded \$267 of this funding to establish Health Information Technology Regional Extension Centers which will support tens of thousands of related jobs such as IT technicians, trainers, nurses, and pharmacy technicians (Manos, April 2010). While the overall Information Technology sector lost approximately 175,000 jobs last year, the healthcare IT sector is anticipated to grow (McGee, 2010). Due to the complex and interdisciplinary nature of healthcare information exchange and the prospects for new jobs, there are rich opportunities to incorporate healthcare information exchange concepts into class curricula and academic research studies.

The purpose of this workshop is to discuss how healthcare information exchange in the U.S. affects our classroom and research agendas. The following are topics to be covered:

- 1. The background of healthcare information exchange based on the workshop leader's work with a variety of state and national organizations involved in healthcare information exchange efforts over the last four years.*
- 2. Ways to incorporate examples of healthcare information exchange into different classes (such as Programming, Database, Networks and Communications, Business Communications, Management of Information Systems) will be discussed. This will emphasize the need to educate the future healthcare IT workforce.*
- 3. Potential areas for future research will be discussed. Healthcare information exchange touches many different areas such as information technology, management, innovation and diffusion, technology adoption, political science, business processes, finance and economics, security, and privacy.*

BENEFIT OF SESSION TO PARTICIPANTS

The attendees will learn ways to incorporate concepts of healthcare information exchange into their classes and that the educating our future health information exchange workforce is critical. Attendees will also discover ways to integrate health information exchange into research areas of interest.

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DOCUMENTING ACCESS RIGHTS USING THE CRUD SECURITY CUBE

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ABSTRACT

The CRUD matrix is an excellent technique to model processes and data and how they interact with respect to creation, reading, updating, and deleting of the data. This paper extends the CRUD matrix to a CRUD Security Cube incorporating a third dimension to document the access rights of users and groups. This user dimension provides significant information without using an additional model or losing any information from the original CRUD matrix in its design. Security administrators may generalize the application of this extension to databases, information systems, or literally any information system's object that incorporates data, processes, and how individuals may interact with those within the object.

Keywords: CRUD matrix, CRUD Security Cube, access controls, access rights, permissions

INTRODUCTION

Organizations need to ensure each employee has the appropriate access to information, but does not have excessively powerful access rights. As systems become more complex, organizations grow in size, the use of contractors and temporary employees increase, and inter-organizational information systems become more common the difficulty of ensuring only authorized users have access to information increases. Kamens (2007) describes challenges faced by auditors and organizations when a company hires, fires, loses, or moves employees. Given the size of staff and the quantity of information employees need access to, regulating and monitoring this access is difficult. At the same time, new laws such as Sarbanes-Oxley Act place greater importance on this. Kamens suggests companies develop pre-defined specifications for the access rights employees need to do their jobs. Essentially, Kamens states the need for access control entries and access control lists as described by Govindavajhala (2006). While products exist to manage access rights (Hulme, 2003), first organizations must carefully define the access rights needed. Additionally, over time organizations must maintain control over user access to information. In the case of publicly traded organizations, these organizations must attest to the control of access to information.

This paper outlines a technique for defining the appropriate access rights using an extension of the CRUD (create, read, update, and delete) matrix, called the CRUD Security Cube (abbreviated as CSC here). The CSC adds a third dimension in which security administrators can model users and groups and their access rights. Incorporating this third dimension of information within the existing CRUD matrix is significant in aiding business and information technology professionals with modeling how access rights apply to both processes and the data within an organization. In practice, this cube extension to the CRUD matrix allows security administrators to view slices of the matrix. Depending on the informational needs, the security administrator could 'slice' the cube as needed to find relevant data on any or all of the three dimensions modeled in the CSC. The user-dimension extension in the CSC applies to access rights in a variety of systems, including software suites, applications, or database management systems.

The organization of this paper is as follows. In the first section, this paper describes the structure and role of the CRUD matrix. In the second section, this paper discusses mandates to protect information as they relate to access management. In the third section, this paper outlines techniques for specifying access rights in information system settings. In the fourth section, this paper describes an accounts-receivable application used to demonstrate the creation of a CSC. In the fifth section, this paper describes the CSC. In the sixth section, this paper discusses potential benefits of the CSC.

The CRUD Matrix

The traditional CRUD matrix is one popular approach to modeling data and process interactions enterprise wide (Politano, 2001). The CRUD matrix maps the processes to data in a two-dimensional table format. Each cell documents the specific access requirements a process needs when interacting with an object. The CRUD matrix supports Create, Read, Update, and Delete access requirements. Knowing which processes Create, Read, Update, and Delete (CRUD) what data assists the database designers and security administrators in storing data and creating processes that effectively manage and manipulate specific data (Oppel, 2004). Figure 1 is an example of a CRUD matrix for an accounts receivable application. As shown, any cell without an explicit access type specification indicates an implicit denial of access.

FIGURE 1: SAMPLE CRUD MATRIX

		Data					
		Customers	Orders	Shipments	Invoices	Adjustments	Receipts
Process	Receive Order	CRU	CRU	R	R	R	R
	Ship Order	R	R	CRU			
	Invoice Shipped, Unbilled Order	R	R	RU	CRU	R	R
	Request Adjustment	R	R	R	R	CRU	
	Approve Adjustment	R	R	R	R	RU	
	Receive Payment	R			RU		CRU
	Perform Account Inquiry	R	R	R	R	R	R

As shown in the example above, the CRUD matrix provides a two-dimensional representation of data and processes and the interaction that exists between them with respect to creating, reading, updating, and deleting of data. In today's business environment, in addition to implementing the best possible business processes, organizations must ensure all data captured are secure.

Security Mandates and Access Management

The CIA triangle is an enduring model for identifying critical information system security needs (Whitman & Mattord, 2005). The CIA triangle addresses three issues: confidentiality, integrity, and availability. All three issues are relevant to access rights. Confidentiality requires only authorized users have access to sensitive information. Integrity requires only persons with a need to create, modify, or

delete data have these rights. Availability dictates access rights enable authorized users to retrieve information when needed. To meet the requirements of the CIA triangle, systems must utilize sufficient controls to ensure protection of information.

While the CIA triangle identifies general goals of information systems security, legislative acts have created specific legal requirements that many or all organizations must meet. Examples of these include the Family Educational Rights and Privacy Act (FERPA), Health Insurance Portability and Accountability Act (HIPAA), and Sarbanes-Oxley Act (SOX). FERPA focuses on the privacy of educational records. FERPA requires educational institutions to limit the disclosure of information to persons other than the student who is the subject of the information. This limitation applies to both external and internal parties. Lowe (2005) describes the need to protect information on a need-to-know basis, which includes a need to restrict internal access to information. The HIPAA privacy rule (United States Department of Health and Human Services, 2003) establishes privacy practices related to protected healthcare information maintained by covered entities, generally including organizations handling patient information. The HIPAA privacy rule limits the disclosure of individually identifiable health information. Although much of the attention about the privacy rule focuses on disclosure to external parties, the privacy rule requires covered entities to ensure internal users only have access to information required to fulfill their individual roles. The primary purpose of SOX is to ensure investors have confidence in capital markets (Anand, 2008). Section 404 requires covered businesses maintain a system of internal controls for financial systems and reporting. Implicit in this requirement is the need to protect information from unauthorized access by internal users, in particular ensuring proper segregation of duties over activities that maintain financial information.

The CIA triangle, FERPA, HIPAA, and SOX require organizations maintain adequate control over information. This applies to both external and internal users of information. To fulfill this requirement, organizations must implement access controls to ensure only authorized users may create, maintain, delete, and access information.

Controlling Access to Resources

Access rights, also known as permissions or privileges, define the types of access a user or group has to a securable object. Common options for defining access rights include specifying access rights for individual users and/or for groups. Unix identifies three recipients of access rights: an object's owner, a group, and the world (December, 2008). Starting with the NT File System (NTFS), users and groups may be recipients of access rights (Melber, 2006) under Microsoft Windows. In many settings, it is more efficient to define access rights in terms of groups, rather than individual users, and then assign individual users to groups. This simplifies the security management process as needs change. In this case, users with extensive access needs are members of multiple groups. Henceforth, this paper uses the term "user" to refer to both users and groups. The nature of securable objects varies across systems; common securable objects include directories and files, devices, executables, and other objects (Changing Access Security on Securable Objects, 2008). The CRUD matrix provides a base set of access types appropriate for many information systems and databases. Beyond this, access types vary across operating systems; common access types include full control, modify, read & execute, read, and write under NTFS (Melber, 2006; Eckel, 2007) and read, write, and execute under Unix (December, 2008). As illustrated in Figure 2, NTFS provides extensive advanced access types depending on the securable object (Mullins, 2006).

FIGURE 2: NTFS ADVANCED ACCESS TYPES (MULLINS, 2006)

Traverse Folder/Execute File
List Folder/Read Data
Read Attributes
Read Extended Attributes
Create Files/Write Data
Create Folders/Append Data
Write Attributes
Write Extended Attributes
Delete
Read Permissions
Change Permissions
Take Ownership

NTFS provides advanced mechanisms to extend access rights including inheritance and the ability to deny explicit access (Melber, 2006; Mullins, 2006; Eckel, 2007). In NTFS, the specification of access rights is either explicit or inherited. Securable objects such as files and directories may inherit access rights from parent securable objects, or may receive access rights through explicit assignment. Additionally, NTFS provides a mechanism to deny a user any particular access type. In NTFS, each access right forms an access control entry (ACE) and the collection of access control entries form an access control list (ACL) (Govindavajhala, 2006; Introduction to Securing Your Windows Computer Files, 2001).

Ferraiolo (1992) and Ferraiolo (1995) describe three types of access controls: mandatory access controls (MAC), discretionary access controls (DAC), and role-based access controls (RBAC). Under DAC, users may grant or deny access to objects under their control. DAC is the weakest form of access control; however, it is appropriate in settings not involving sensitive information because of its simplicity and local control. With MAC, before a user gains access to an object, the user must receive formal clearance to access the object. An administrator is responsible for clearing the user based on the sensitivity of the information in the object and the authorization level of the user. The user does not receive authorization to grant other users access to the object. RBAC is a type of MAC. In RBAC, the user has a specific role to perform in the organization. An administrator determines the transactions associated with the role. Each transaction has associated objects and types of access to these objects. From this, the user's roles specifically determine the types of access the user has to various objects.

Challenges implicit with all three types of access controls include identifying and documenting the appropriate access rights associated with users. In many cases, administrators employ a trial-and-error strategy that may result in over or under assignment of access rights. In the case of under assignment of access rights, users are unable to perform necessary job functions until an administrator resolves the problem. With over assignment of access rights, the consequences have the potential to be more significant, enabling users to perform undesired actions or resulting in the disclosure of information (Kamens, 2007). Additionally, if a user receives excess access rights, the user may not inform the appropriate security administrator due to lack of awareness of the problem or the intent to engage in fraud. Alternatives to the trial-and-error approach include employing use cases (Firesmith, 2003), extensions to the Unified Modeling Language (UML) to incorporate security information (Breu, 2007), and the use of RBAC (Ferraiolo, 1992; Ferraiolo, 1995). Additionally, conventional data flow diagramming techniques provide sufficient information to identify necessary access rights.

An Accounts Receivable Application

To illustrate the application of the CSC, this paper uses a simplified accounts receivable (AR) application. Figure 3 is a context data flow diagram illustrating the main flows between the system, customer, and bank. Figure 4 enumerates the processes that comprise the system; once again, this is a simplified view of an accounts receivable system. This system uses a bank lockbox for receiving payments; as a result, the customer sends the payment directly to the bank and the bank reports on receipts so the company may update the AR records. This paper presents two of the data flow diagrams depicting the processes listed. Figure 5 is a data flow diagram for the Receive Order process. Figure 6 is a data flow diagram for the Adjust Account process. Since this process involves two users, it consists of two child processes, each assigned to a specific user: Request Adjustment and Approve Adjustment. Figure 7 is a data model depicting the major tables maintained by this system; for the sake of parsimony, this data model is a simplified view of the database structure.

FIGURE 3: ACCOUNTS RECEIVABLE CONTEXT DFD

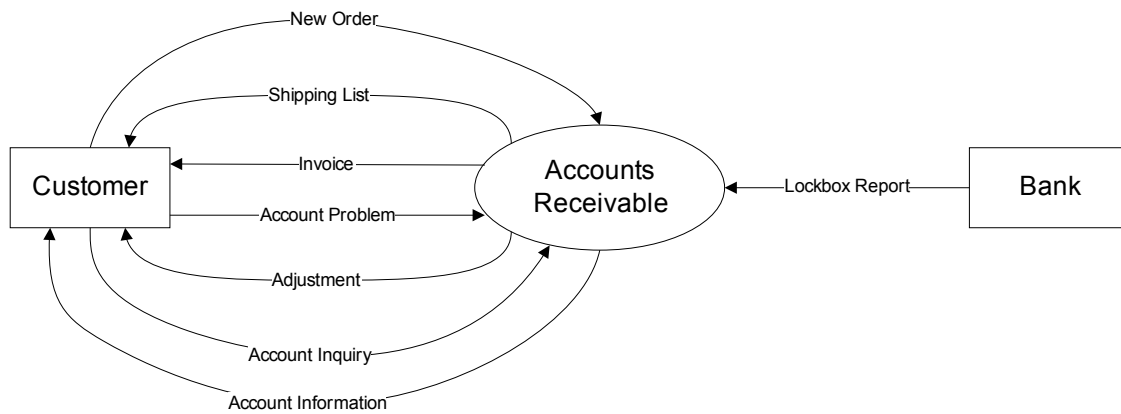


FIGURE 4: ACCOUNTS RECEIVABLE PROCESSES

Process	Description	Agent
Receive Order	Receive an order from a customer and create a record of the order.	Sales Representative
Ship Order	Package a new order and ship the order to the customer.	Shipping
Invoice Shipped, Unbilled Order	Generate an invoice for an unbilled order.	Billing Clerk
Request Adjustment	Receive a request for an adjustment to an account from a customer (e.g., credit or debit memo).	Sales Representative
Approve Adjustment	Approve or deny an adjustment request and notify the customer.	Sales Manager
Receive Payment	Receive notification of a payment received by the bank via a lockbox.	A/R Clerk
Perform Account Inquiry	Provide the customer with information about the status of the customer's account.	various parties

FIGURE 5: RECEIVE ORDER DATA FLOW DIAGRAM

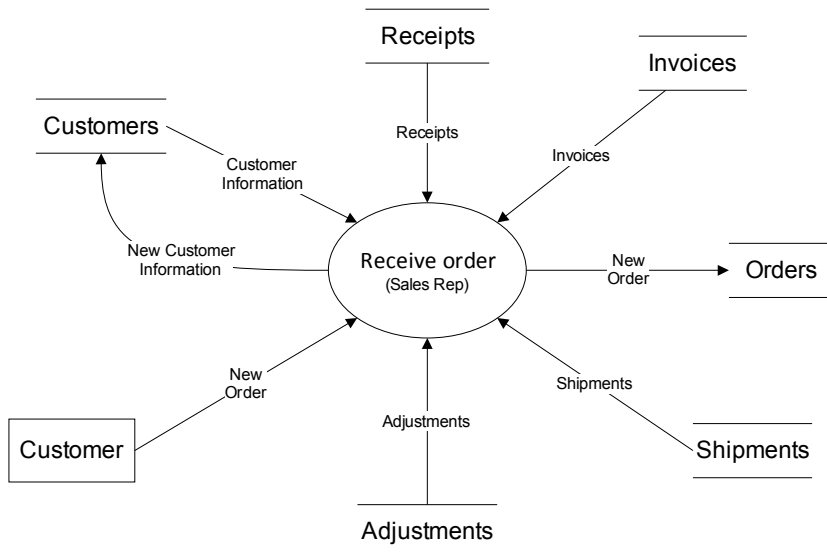


FIGURE 6: ADJUST ACCOUNT DATA FLOW DIAGRAM

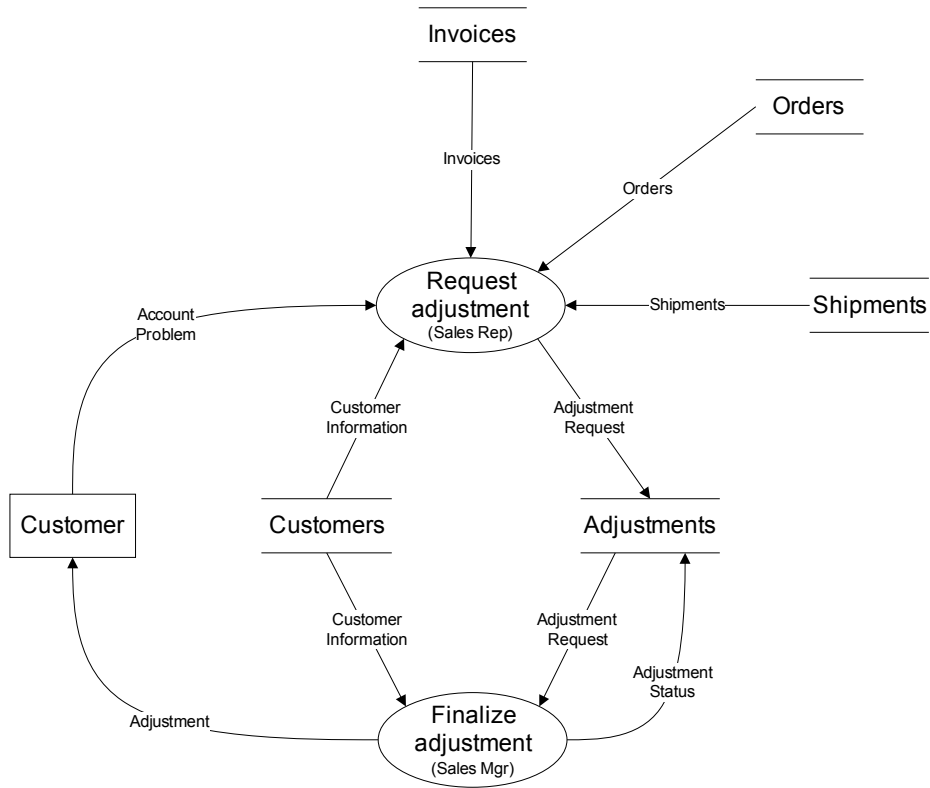
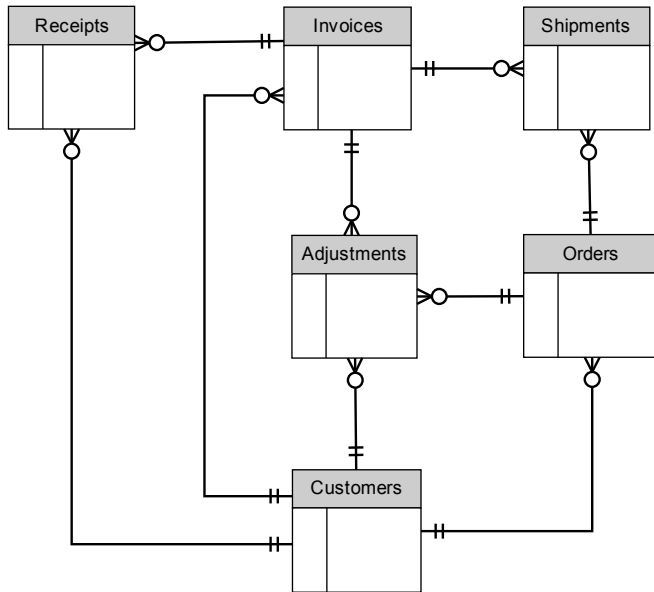


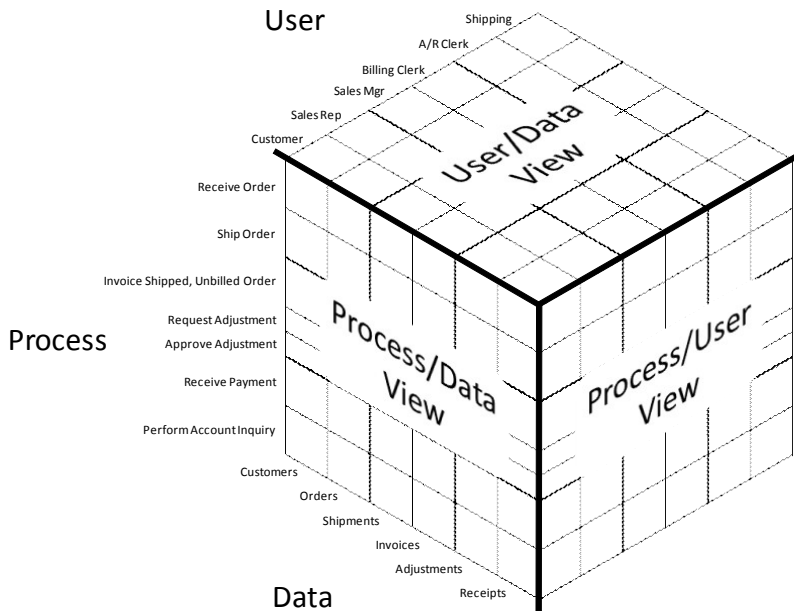
FIGURE 7: ACCOUNTS RECEIVABLE DATA MODEL



The CRUD Security Cube

The CSC extends the standard CRUD matrix by adding a third dimension representing users (Figure 8). Using this dimension, security administrators can document the appropriate access rights for users to processes and data. The CSC is appropriate when designing security for information system applications that employ processing units such as programs, data access forms, or similar objects to access data in a database. Additionally, this specification is appropriate in any setting where the user employs specific programs to access objects; this provides a mechanism for documenting the programs users need access to and the data the programs access.

FIGURE 8: CRUD SECURITY CUBE



As shown in Figure 8, the CSC consists of three views: the Process/Data view (Figure 1), the Process/User view (Figure 9), and the User/Data view (Figure 11). Each view depicts the system and security from a particular perspective.

The Process/Data view is a standard CRUD matrix that documents the data requirements of each process. To create this view, a security administrator may examine system artifacts such as design documentation, evaluate existing application security settings, analyze code, or otherwise identify the data requirements. The security administrator must ensure each process represents a discrete unit of work performed by one user. In the case of complex processes, the security administrator must break the process into lower-leveled, more detailed processes. This is essentially the same as decomposing a process on a set of data flow diagrams. The data access requirement varies based on the nature of the process. In general, a process will read from a variety of data stores, receive input from a user, and generate output to one or more data stores. In some cases, the data units created or updated by a process require careful control. For example, in the case of segregation of duties, one user may create a record in a data store but not have access to a particular field or fields. Another user may have access to the protected fields using a different process. In situations such as this, the security administrator must carefully evaluate the data needs for a process and specify these needs at the lowest level of granularity necessary to maintain proper controls; for example, the security administrator may identify a field in a data store that the user does not have permission to access. In a different process, another user may have access to the field.

Figure 9 is a Process/User view from the CSC. The Process/User view depicts the access rights of users to processes. To create this view, a security administrator may examine application menus and other

application interfaces, physical design models, organizational charts, and job descriptions, as well as interview users and managers. To ensure consistency with the Process/Data view, one may start with the process definitions listed on the Process/Data view. In this view, one may identify any user permitted to perform a process using an X (execute) in the corresponding cell.

FIGURE 9: PROCESS/USER VIEW

		User					
		Customer	Sales Rep	Sales Mgr	Billing Clerk	A/R Clerk	Shipping
Process	Receive Order		X				
	Ship Order						X
	Invoice Shipped, Unbilled Order				X		
	Request Adjustment		X				
	Approve Adjustment			X			
	Receive Payment					X	
	Perform Account Inquiry	X	X	X	X	X	

The User/Data view depicts the objects each user may access and the corresponding level of access. To determine a user's effective access rights, the security administrator identifies the processes performed by the user and the corresponding objects. For each object, the security administrator determines the maximum access rights required by the user; the maximum access rights for an object consists of the union of the access rights for the object for all processes performed by the user. This is a form of RBAC using individual processes to determine the roles users play. For example, in Figure 10 the A/R clerk has access to the Receipts object via the Receive Payment and Perform Account Inquiry processes. The Perform Account Inquiry process gives the user Read access and the Receive Payment process gives the user Create, Read, and Update access. As a result, the user's access to the Receipts object must be Create, Read, and Update.

FIGURE 10: A/R CLERK'S ACCESS RIGHTS TO RECEIPTS OBJECT

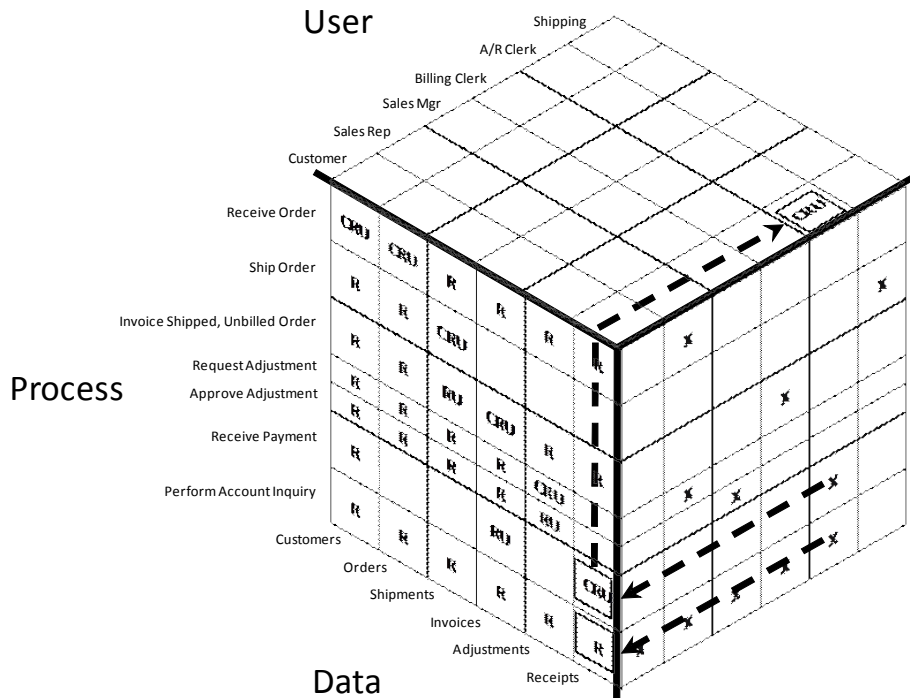


Figure 11 is a full User/Data view of the CSC. This depicts all users' access rights for all objects. This enables the security administrator to implement access rights within a database to ensure each user has access to the objects required and no user has unneeded access rights. Figure 12 highlights the access rights for a specific user. This illustrates the relationship between processes, data, and the designated user.

FIGURE 11: USER/DATA VIEW

		User					
		Customer	Sales Rep	Sales Mgr	Billing Clerk	A/R Clerk	Shipping
Data	Customers	R	CRU	R	R	R	R
	Orders	R	CRU	R	R	R	R
	Shipments	R	R	R	RU	R	CRU
	Invoices	R	R	R	CRU	RU	
	Adjustments	R	CRU	RU	R	R	
	Receipts	R	R	R	R	CRU	

FIGURE 12: USER SLICE FOR THE BILLING CLERK

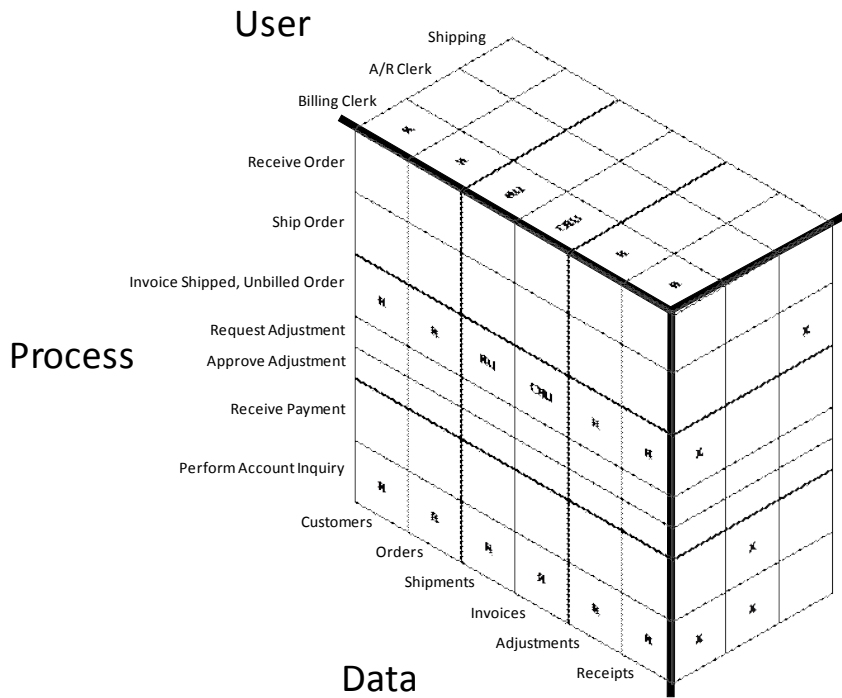
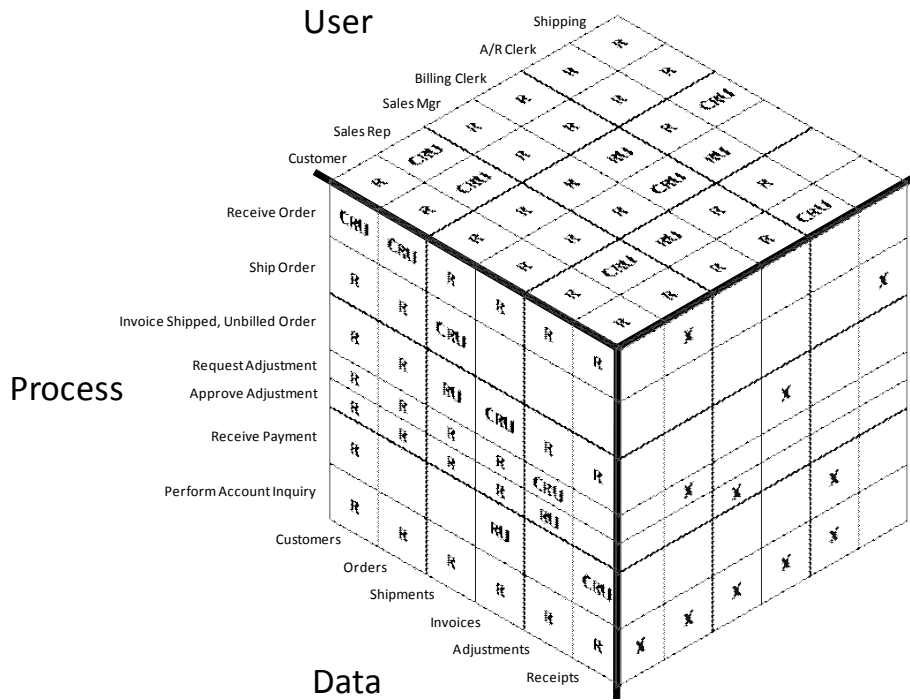


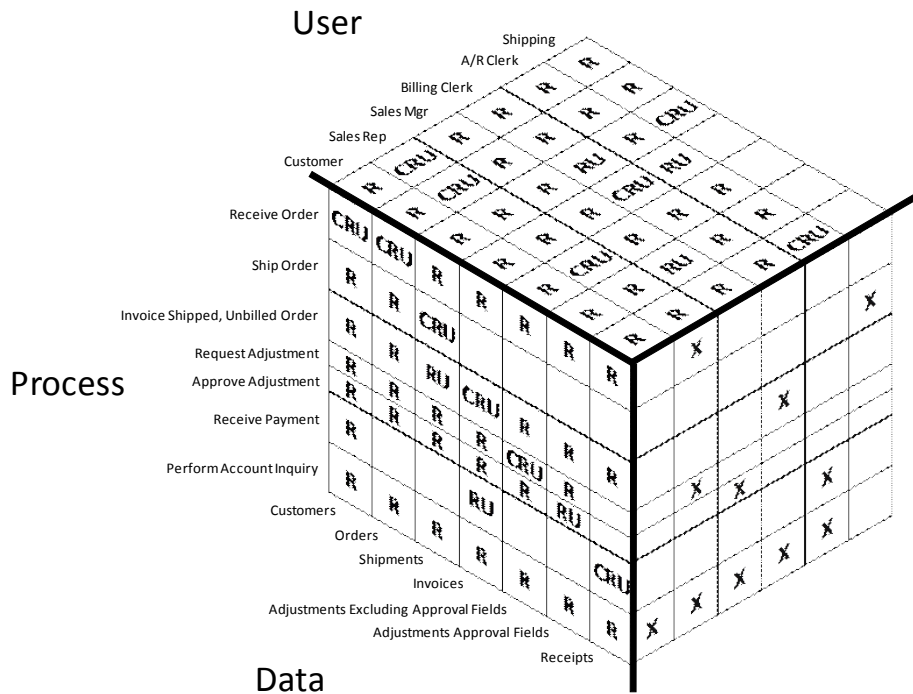
Figure 13 presents the final CSC for the AR application. It identifies the appropriate level of access to each object for each user. For this simple example, this paper presents the determination of effective access rights manually. In complex settings, a software application could generate the effective access rights given the Process/Data view and Process/User view. In addition, software could update system access rights based on the access rights defined in the CSC.

FIGURE 13: FINAL CRUD SECURITY CUBE FOR THE AR APPLICATION



As discussed briefly above, to ensure adequate security the CSC must present processes and objects at the appropriate level of granularity. An individual user should perform each process; if a process requires actions by multiple users, the security administrator should break down the process into more detailed processes, each performed by an individual. In the case of objects, some processes may utilize all fields in an object while other processes may utilize only a subset of fields. To ensure appropriate control within the system, in some cases it is critical a system limit operations on a subset of fields to one or a small group of users. In the AR example, there is a need to regulate access to fields in the Adjustments object. When the salesperson creates a new adjustment, the system needs to ensure the sales manager formally approve the new adjustment. As a result, the salesperson may have no access to approval fields when performing the Request Adjustment process. When the sales manager performs the Approve Adjustment process, the sales manager needs access to these fields. Based on this, the approval fields require special permissions. Figure 14 illustrates this additional information.

FIGURE 14: CRUD SECURITY CUBE WITH ADJUSTMENTS DETAILS



Benefits of the CRUD Security Cube

There are a number of potential benefits from the CSC technique for defining and documenting access rights.

- This technique presents access rights in an easily understood format; one may render each view as a table.
- This technique provides a means of clearly depicting access rights prior to the implementation of these access rights.
- This technique creates an artifact to demonstrate compliance with legal and contractual requirements.
- Security administrators and auditors may use the documentation to identify access rights conflicts, including situations where a user has either excess or insufficient access rights.
- The a priori documentation of access rights provides a baseline for security administrators and auditors to assess the implementation of the access rights to ensure an adequate level of information and system protection.

- This technique does not rely on a specific analysis method and should work well with structured and object oriented methods.
- This technique is adaptable to various types of securable objects, including information systems, directory structures, workstation resources, network resources, as well as others.
- As described earlier, different systems provide different access types for objects. The CRUD access types provide a good foundation; however, the CSC technique is easily extensible to various types of access such as those available in NTFS.

The CSC is not without challenges. One significant challenge is managing all of the details about processes, user assignments, and objects to secure. Even in a small system with a limited number of users, it is impractical to assume that a security administrator can manage these details without the aid of software. The simplest solution is to create a spreadsheet to maintain this data. A better solution is a software tool that can manage the data as discussed below. A second challenge is the actual collection of the data required to create the CSC. For publicly traded organizations, the need to comply with SOX rules means personnel are already collecting this data to fulfill section 404, which requires that management attest to the sufficiency of internal controls. Organizations not required to comply with section 404 will need to engage in a process analysis project to gather this data; this project has the side benefit of helping management to understand better the processes. The third challenge is that people have trouble with three-dimensional visualizations. Fortunately, the three faces of the CSC provide all information required to establish access rights; as a result, one can view the three views to find the necessary information.

In addition to the benefits of the CSC, there are several potential extensions to this basic CSC specification. One extension addresses the inclusion of administrative access types. The CRUD access types address using existing objects in a database. In a database setting, various commands exist to create and maintain the structure of the objects stored, such as data definition commands in a relational database setting. In situations where multiple database administrators manage the structure of a database, extending the CRUD model to include data definition commands is appropriate. A second extension utilizes the CSC to model access to other objects such as directories, files, and hardware devices. The nature of the object determines the appropriate access types needed; for example, directories and files require access types similar to those supported by NTFS. A third extension explores the inclusion of concepts such as explicit denial, access type inheritance, and similar concepts as applied in NTFS. These techniques offer the potential for powerful, but parsimonious specification of access rights. A fourth set of candidate extensions deal with the time dimension. One time-dimension issue deals with the retention of historical access rights to ensure tracking of the evolution of access rights over time and auditing of past object access against access rights in effect at the time. A second time dimension issue models access rights as they apply to windows; for example, in a typical course registration system students may register during certain periods, drop courses during other periods, and display registration information at other times. As a result, access rights vary based on the period in which the user accesses the system. A final extension involves developing a software prototype to maintain the process/data view, the user/process view, and generate the user/data view based on the two specifications. In addition, the software prototype can generate scripts, batches, or other mechanisms to set the access types on objects.

SUMMARY

This paper presented the CRUD Security Cube. The CSC is an extension of the CRUD matrix. It incorporates a user dimension. The user dimension transforms the CRUD matrix into a three-dimensional construct. The CSC enables one to identify the data used by processes, the processes performed by users,

and the data required by users. This yields a number of benefits, including the ability to define access rights prior to implementation, ensure users have necessary access rights without excess access rights, implement necessary access rights in applications and databases, and audit access rights. These capabilities should assist organizations in complying with legal requirements.

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RELIABILITY ASSESSMENT OF A SURVEY INSTRUMENT

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ABSTRACT

In a data oriented project, the reliability of results essentially depends on the reliability of the data collected, which depends on the reliability of the survey instrument used. So the reliability of the instrument becomes an important issue. The purpose of the paper is to explain the design and implementation of a system to assess the reliability of a survey instrument. Some of the popular software systems such as SPSS do have reliability procedures to compute reliability of an instrument. However, we have designed and implemented a system that is standalone, user friendly, and does not need specific technical knowledge of software to use. We have also achieved a high degree of automation for user convenience. This system would be useful and convenient in the assessment and construction of a survey instrument in research.

INTRODUCTION

For quantitative research, researchers develop a survey instrument consisting of items as a part of measurement procedure. These items need to have consistency of measurement for what it is supposed to be measuring. If the consistency of the items in a survey was questionable, then the results derived from that survey instrument would be questionable and so not reliable to use. This consistency is called reliability in quantitative research. Another way to look at reliability is to consider the correlation of an item or instrument with a hypothetical one which truly measures what it is supposed to. Since the true instrument is not available, we need to estimate reliability in different ways. There are four different ways to estimate reliability:

1. **Internal Consistency Reliability:** It is used to establish the consistency based on the correlation among the items of the survey instrument. The same instrument is administered to a group of subjects on one occasion to estimate reliability.
2. **Parallel-Forms Reliability:** It is estimated based on the two equivalent survey instruments of the scale constructed in the same way.
3. **Test-Retest Reliability:** It is estimated based on the correlation between two or more administrations of the same survey instruments on the same (or similar) sample at different times or locations, assuming there is no substantial change in the scale being measured between two administrations. The amount of time allowed between measures is critical, because longer the time interval, lower the correlation and so lower the reliability.

4. Inter-rater Reliability: It is estimated based on the correlation of scores between/among two or more raters/interviewers who rate the same survey instrument for the same sample. To get the expected outcome, the raters should be as blind as possible and should be randomly assigned.

Reliability is a property of the *scores of a measure* rather than the measure itself and is thus going to be *sample dependent*. Reliability analysis allows us to study the properties of measurement scales and the items that make them up. Data can be dichotomous, ordinal, or interval, but they should be coded numerically. Observations should be independent, and errors should be uncorrelated between items. Each pair of items should have a bivariate normal distribution. Scales should be additive, so that each item is linearly related to the total score. There are many other factors that could affect the reliability such as total number of questions in a survey and quality of the questions. More number of questions as well as effective questions will improve the reliability of the survey. In this paper, the researchers would like to focus on reliability of the data, and the computerized system developed to check the reliability of the survey instrument. The system we developed is a self-contained standalone system and does not need any statistical software to run this system. It is menu-driven and user does not need to know any commands. User also does not require any expertise of any statistical software to use this system. The system has a high degree of automation (only a few keystrokes) to perform a complete reliability analysis [1][11][15][18][21].

CONCEPTUAL MODELS

The conceptual models used to construct the reliability system are:

Alpha (Cronbach) Model: This is a model of internal consistency, based on the average inter-item correlation. The alpha reliability of the variable is derived by assuming each item represents a retest of a single item. For example, if there are five items, it's as if the five scores are the retest scores for one item. But the reliability is calculated in such a way that it represents the reliability of the *mean* of the items, not the reliability of any single item. So, for example, the alpha reliability of 10 items would be higher than that of 5 similar items. Alpha reliability should be regarded as a measure of internal consistency of the mean of the items at the time of administration of the questionnaire. It is not test-retest reliability. For that, the questionnaire has to be administered on two or more occasions. For dichotomous data, alpha coefficient is equivalent to the Kuder-Richardson 20 (KR20) coefficient.

Split-half Model: This model splits the scale into two parts and examines the correlation between the parts. It computes correlation between forms, Guttman split-half reliability, Spearman-Brown reliability (equal and unequal length), and coefficient alpha for each half.

Guttman Model: This model computes Guttman's lower bounds for true reliability. Reliability coefficients are λ_1 through λ_6 .

Parallel Model: This model assumes that all items have equal variances and equal error variances across replications.

Strict Parallel Model: This model makes the assumptions of the parallel model and also assumes equal means across items.

Parallel and Strictly Parallel Model: This model computes test for goodness-of-fit of model, estimates of error variance, common variance, and true variance, estimated common inter-item correlation, estimated reliability, and unbiased estimate of reliability [9][10][11][16][23].

RELIABILITY SYSTEM

Based on the models explained above, the researchers developed the computerized reliability system. The system has several modules to collect the information about a data file to estimate reliability for the survey instrument on which data was collected. A data file consists of data lines and a data line consists of data-fields. Data-fields represent items in a survey form and association between data-fields and items has to be left to right and one to one. The model and implementation of the reliability system is explained below.

SYSTEM MODEL

The system model is essentially composed of three main modules: User Interface Module, Processing Module, and Output Module. A procedural architecture of the system is shown in Figure 1.

User Interface Module

The user interface module contains the mouse and keyboard event handlers to collect information from the users regarding the total number of data-fields in the data-file and locations of a data file and an output file.

Processing Module

The processing module consists of several submodules, each one responsible for processing specific tasks, such as accessing the values of each data-field, processing the data, computing several types of statistical analysis, estimating reliability of the instrument based on different reliability models.

Output Module

The output module is responsible for saving the results created by the processing module in an output file and displaying the results [3][4][8][14] [22].

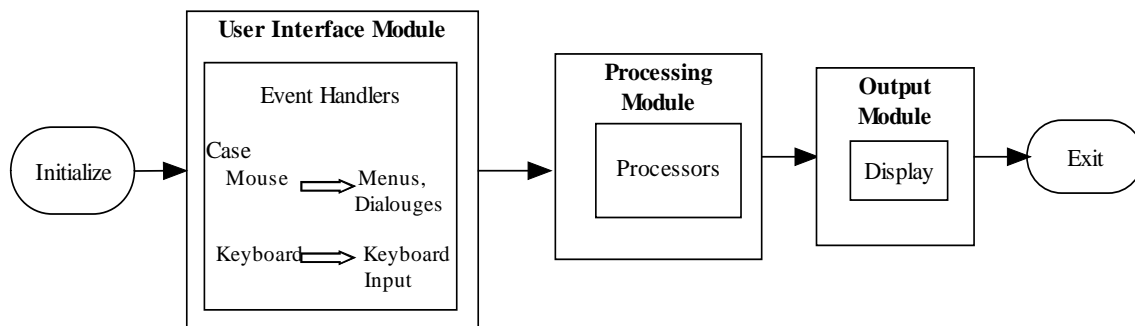


Figure 1. Procedural Architecture of the System

IMPLEMENTATION

A prototype of the system is implemented in the Microsoft Windows environment. The menu driven graphic user interface is implemented using the current GUI techniques. User dialogues are implemented to collect user input as needed.

The heart of the system is the processing module that is implemented by the main processor. The processor consists of several subprocessors that are responsible for specific tasks such as processing user inputs, processing data, and performing necessary computations by implementing the conceptual models on the data.

In this process, several types of descriptive and inferential statistics are generated. Descriptive statistics on items such as individual item means and standard deviations, as well as, correlation coefficients are generated. In addition, item-total statistics are also generated, where the Cronbach Alpha coefficient of reliability is computed with the scale mean, scale variance, and corrected item-total correlation for each case in which an individual item is deleted. This will aid in estimating the relative contribution of each item to the overall instrument. Cronbach Alpha and Standard Alpha reliability coefficients are computed to estimate the reliability of the instrument. Spearman-Brown and Guttman coefficients can be generated for the split-half model in addition to the alpha coefficient for each part. If the total number of items in the sample is odd, the system will divide the sample into two parts with the first part having one more item. The system saves all the generated results in the output file.

The output module is implemented by the display procedures using data aware controls. It displays the results of the reliability analysis and the results will be saved in a text file that can be opened by any text editor or word processor [2][4][5] [6] [12] [13][19][20][22].

TESTING

The testing of this system was done on more than one data set. A data file with at least two subjects and at least four items is required to cover all the categories of reliability analysis generated by this system. A data set used for testing in the following example contains 18 items and 268 subjects.

This menu driven system collects the necessary input from user through menus and user dialogues. The output file that contains results of the reliability analysis on the data file after running the reliability system on the test data is shown below (on the next page) in Figure 2. The output generated by the system consists of several sections such as correlation matrix, item statistics, item-total statistics, and various reliability coefficients. Results of each section start on a new page in the original output though here the output is provided without page breaks.

RELIABILITY ANALYSIS

CORRELATION MATRIX

ITEMS	1	2	3	4	5	6	7	8	9
1	1.0000								
2	0.2509	1.0000							
3	0.7117	0.2183	1.0000						
4	0.5385	0.3338	0.5346	1.0000					
5	0.1953	0.3092	0.2714	0.4434	1.0000				
6	0.2870	0.3850	0.2882	0.3854	0.3919	1.0000			
7	0.3869	0.3849	0.3368	0.3118	0.5427	0.5465	1.0000		
8	0.2196	0.4313	0.1408	0.3554	0.5577	0.3460	0.5523	1.0000	
9	0.2868	0.3599	0.1700	0.4589	0.6311	0.3234	0.5611	0.6941	1.0000
10	0.2697	0.1268	0.1333	0.1564	0.2639	0.1758	0.1584	0.2533	0.2919
11	0.5469	0.3210	0.4826	0.6226	0.5204	0.3435	0.5107	0.5352	0.6210
12	0.6230	0.3276	0.4948	0.4373	0.2732	0.4131	0.4757	0.3326	0.2805
13	0.3992	0.2895	0.4558	0.5180	0.4130	0.3806	0.4123	0.3215	0.3509
14	0.2376	0.4029	0.1733	0.3715	0.2632	0.4617	0.4215	0.3752	0.3878
15	0.4952	0.3007	0.3449	0.4533	0.5432	0.5132	0.5484	0.5374	0.5765
16	0.5270	0.2998	0.4456	0.3981	0.2563	0.2949	0.4541	0.4015	0.3548
17	0.5096	0.3422	0.4546	0.4309	0.4453	0.4536	0.6373	0.4256	0.4216
18	0.5282	0.2615	0.4550	0.5063	0.4929	0.2986	0.4220	0.4145	0.4485

ITEMS	10	11	12	13	14	15	16	17	18
10	1.0000								
11	0.3227	1.0000							
12	0.2956	0.5068	1.0000						
13	0.0208	0.5635	0.3622	1.0000					
14	0.1153	0.2788	0.2463	0.2074	1.0000				
15	0.5472	0.5618	0.5208	0.2986	0.4092	1.0000			
16	0.3414	0.5223	0.5136	0.3876	0.2816	0.5364	1.0000		
17	0.1199	0.5952	0.5031	0.5445	0.2655	0.3972	0.5462	1.0000	
18	0.4086	0.6429	0.5377	0.3611	0.3043	0.6459	0.5908	0.5067	1.0000

ITEM STATISTICS

TOTAL NUMBER OF ITEMS = 18
 TOTAL NUMBER OF CASES = 268

NO	MEAN	STD DEV
1	1.7500	0.9367
2	2.9030	1.1075
3	1.8955	1.0113
4	2.7239	1.2141
5	2.2687	1.1262
6	3.0933	1.2158
7	2.2052	1.0308
8	2.6530	1.2701
9	2.3694	1.2931
10	3.2052	1.0488
11	2.4478	1.1551

Figure 2. Results on Reliability Analysis of a Survey Instrument

12	2.2164	1.1006
13	1.6903	0.8640
14	3.8209	1.1107
15	2.7500	1.3101
16	2.1716	1.0206
17	2.2537	1.0435
18	2.4552	1.1619

ITEM MEANS	MEAN	MINIMUM	MAXIMUM	RANGE	MAX/MIN	VARIANCE
	2.4930	1.6903	3.8209	2.1306	2.2605	0.2874

ITEM VARIANCES	MEAN	MINIMUM	MAXIMUM	RANGE	MAX/MIN	VARIANCE
	1.2510	0.7464	1.7163	0.9699	2.2994	0.0718

ITEM-TOTAL STATISTICS

STATISTICS FOR SCALE	MEAN	VARIANCE	STD DEV	NO OF VARIABLE
	44.8731	175.6168	13.2520	18

NO	SCALE MEAN IF ITEM DELETED	SCALE VARIANCE IF ITEM DELETED	CORRECTED ITEM-TOTAL CORRELATION	ALPHA IF ITEM DELETED
1	43.1231	160.1084	0.6172	0.9189
2	41.9701	161.0777	0.4736	0.9221
3	42.9776	161.0482	0.5277	0.9207
4	42.1493	154.6892	0.6441	0.9180
5	42.6045	156.9216	0.6176	0.9186
6	41.7799	157.1461	0.5575	0.9202
7	42.6679	156.7170	0.6911	0.9170
8	42.2201	154.2997	0.6244	0.9186
9	42.5037	152.9850	0.6553	0.9177
10	41.6679	164.8668	0.3583	0.9245
11	42.4254	152.4401	0.7658	0.9149
12	42.6567	157.0128	0.6306	0.9183
13	43.1828	162.6443	0.5548	0.9203
14	41.0522	161.2482	0.4656	0.9223
15	42.1231	149.9361	0.7469	0.9151
16	42.7015	158.2926	0.6340	0.9183
17	42.6194	156.9258	0.6733	0.9174
18	42.4179	154.0269	0.7018	0.9165

RELIABILITY COEFFICIENTS

CRONBACH ALPHA COEFFICIENT =	0.9231
STANDARDIZED ALPHA =	0.9232

Figure 2-(cont'd). Results on Reliability Analysis of a Survey Instrument

STATISTICS FOR SPLIT-HALF METHODS

NUMBER OF ITEMS IN PART1 =	9
NUMBER OF ITEMS IN PART2 =	9
MEAN FOR PART 1 =	21.8619
MEAN FOR PART 2 =	23.0112
VARIANCE FOR PART 1 =	48.3966
VARIANCE FOR PART 2 =	46.7602
CORRELATION BETWEEN THE TWO PARTS =	0.8457
EQUAL LENGTH SPEARMAN-BROWN COEFFICIENT =	0.9164
UNEQUAL LENGTH SPEARMAN-BROWN COEFFICIENT =	0.9164
GUTTMAN SPLIT HALF COEFFICIENT =	0.9163
ALPHA COEFFICIENT FOR PART1 =	0.8531
ALPHA COEFFICIENT FOR PART2 =	0.8646

Figure 2-(cont'd). Results on Reliability Analysis of a Survey Instrument

CONCLUSION

In experimental or applied research projects, data becomes an important entity. The collection of data depends on a survey instrument that researchers use. The reliability of the results depends on the reliability of the data collected. The reliability of data in turn depends on the reliability of the instrument used. So the reliability of an instrument becomes an important issue. The purpose of our system is to assess the reliability of the instrument before it can be used. It also gives opportunity to correct and enhance the quality of the instrument before its use. The reliability system is necessary for researchers and analysts since reliable data is important to get the consistent and reliable results from the data. We hope, in this respect, this system would be an important and useful tool for researchers in developing reliable survey instruments for their research.

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DEVELOPMENT AND IMPLEMENTATION OF A WEB BASED DECISION SUPPORT COST ESTIMATOR TOOL FOR THE AL-SAWAF TRADING COMPANY: A CASE STUDY IN SAUDI ARABIA

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ABSTRACT

The purpose of this paper is to describe the development and implementation process of a web-based cost estimator for the Al-Sawaf Trading Establishment (ATE) located in Jeddah, Saudi Arabia. The company currently sells bulk medical supplies and seeks to sell or lease more sophisticated medical equipment to clients in the western region of Saudi Arabia. A major objective of this project was to produce a dynamic online application to replace a paper based system; an added feature includes enhanced effectiveness of ATE responses to in-house sales and improved accuracy and efficiency when responding to requests for quotes.

INTRODUCTION

In the current environment of diminishing resources, managers in business and industry find themselves increasingly more accountable. At various levels within functional business units, they are expected to be more resourceful, inventive, and creative in addressing opportunities and problems. They are expected to see the large and the small picture and provide more advantageous competitive positions for their employers. Their accountability is increasingly being defined as their ability to produce and maintain a specific level of profitability in portion to the utilization of resources.

Profitability can be directly affected by a manager's ability to optimize resources from both internal and external perspectives. As we progressively move toward a more global economy, the ability of managers to optimize those resources is continually being tested. Managers can select from a myriad of options from expanding or developing new technological applications to increasing end-user productivity to identifying and contracting with outsourcing agencies. However, as we move toward more global aspirations, and as goods and services move across international borders, some traditional concerns will continue to exist such as tariffs, infrastructure availability, and exchange rates.

PURPOSE

The purpose of this paper is to describe the development and implementation process of a web-based cost estimator for the medical supply company Al-Sawaf Trading Establishment (ATE) based in Jeddah, Saudi Arabia. Deployment and use of such a system will allow ATE to replace a paper based system while

enhancing the decision making effectiveness of their responses to in-house sales and to requests for quotes in a more accurate and timely manner.

BACKGROUND

The Al-Sawaf Trading Establishment is a private medical supply sole proprietorship formally organized in 2008 to sell medical supplies to hospitals, labs and health care providers. It mainly serves the western region of Saudi Arabia including the cities of Jeddah, Makkah, Madinah, and small populated areas in between those cities.

ATE is still in the category of a startup company. However, in the short period of its existence the company has grown and expanded by meeting and outpacing original growth estimates. From the outset, ATE sought to sell and distribute the most current state-of-the-art medical supplies in bulk. Serving as a “middle man,” supplies are sold reflective of in-house sales marketing efforts and in response to requests for quotes from hospitals, labs, and other providers of medical services. In some instances, medical supplies sold by ATE included shipping costs from vendors and in other transactions those costs were not included.

Besides serving the western region of Saudi Arabia, ATE also seeks to expand to other regions of the Middle East. It has become increasingly evident to management that in order for ATE to remain competitive and to be a more spirited force in the international market of selling bulk medical supplies, they must address how best to position themselves to provide economical pricing while at the same time maintaining profitability.

NEED

Major factors in determining the sales price of bulk medical supplies to customers are driven by the cost of the medical supplies to ATE, whether the cost of those supplies includes shipping charges for delivery to ATE's warehouse, and currency exchange rates. Reflective of those factors, ATE wanted to develop an on line web-based application to provide more accurate final cost estimations for itself in order to respond more competitively to in-house sales and in response to requests for quotes. However, they have found that different methods of shipments from various national and international vendors often decreases the expected level of profitability in the resale of those supplies. To date, quote responses have been paper bound making it difficult to provide quotes as accurate or as timely as they would desire. Specifically, management at ATE would like to provide more accurate quotes including shipping costs from vendors without decreasing profitability inside Saudi Arabia while taking into account currency exchange rates. Hence, the focus of this project is not to develop a web-based application inclusive of all components, but to provide ATE employees with an end-user friendly web-based cost estimation of products being sold to clients that is inclusive of different shipping costs at the time of purchase from vendors. At a later time, this information can be included in a fully developed application.

THEORETICAL FRAMEWORK

An adaptation of the Software Engineering Research Methodology (SERM) framework (Gregg et al., 2001) was used in the development of this application. SERM combines traditional software development lifecycles and new technologies resulting in tangible, well-documented, software (Gregg et al., 2001). For example, SERM adheres to three tenets of software engineering: a conceptual overview,

formal specifications, and the development process itself. Overall, software engineering is a function of all three tenets, but understanding and documenting system requirements is the focal point of the SERM framework. The conceptual overview is followed by mathematical, logical, graphical, and structured natural language requirements and then by the development of the system. For more information on the SERM framework please review (Gregg et al., 2001).

The waterfall software development lifecycle was utilized to provide operational boundaries within the SERM framework. The waterfall software development lifecycle seemed appropriate for three reasons: (1) it provides a structured approach; (2) it progresses linearly through discrete, easily understandable and explainable phases (e.g. planning, requirements and analysis, design, development, and testing); and, (3) it provides easily “visible” milestones in the development process (Sommerville, 2008).

PROJECT OVERVIEW AND SCOPE

For ATE, a web-based decision support cost estimation tool should allow employees of ATE to access and run the application on the company’s server, provide a calculated price for the product(s), allow the cost estimation to be saved, and provides output to upper management for their review and approval. As an extension of the cost estimation tool, managers should have access to client quotes, have clearance to modify and edit them as deemed necessary. In addition, management should be able to further adjust quotes for favored customers who purchase supplies in unusually large quantities giving them an adjusted price. From the standpoint of critical success factors, the project will be deemed profitable if the following criteria can be met:

1. Users should easily access and understand forms through a graphical user interface, be able to calculate accurate final product cost estimates, and forward the results to management, and
2. Management can view, approve, and print results displayed on a form in a dynamic environment.

PROJECT DOCUMENTATION

To achieve those objectives a modified waterfall approach (Sommerville, 2008) provided a framework within which developers could adjust their abstractions of the problem and development process in a constructive manner. To begin the project development process, an initial *Al-Sawaf Trading Establishment Project Planning Document* was created. The draft was developed and revised with the kind consultation of Dr. Khaled Al-Sawaf, (President, Al-Sawaf Trading Establishment, Jeddah, Saudi Arabia). While it was initially thought that communication with the client would be an issue. The use of the online video communication (i.e. Skype®) enabled regularly scheduled meeting times. In the document, project resources, key stakeholders, major risks, and solutions to minimizing risks were identified. At this beginning phase, major risks were determined to be related to technology, understanding requirements from ATE, and time estimation. Some of those risks included:

- Development of a dynamic online application could be subject to hardware and power failures causing loss of work,
- Requirement changes by ATE during production could have a direct impact on development efforts,
- Completing the project on time might be difficult,
- Unclear requirements by ATE might impact completion,
- Project expectations might fluctuate, and

- Time needed to finish might be underestimated.

From that document and from consultations with Dr. Al-Sawaf, a second document, *Al-Sawaf Trading Establishment Requirements Specification Document*, was developed to provide a more in-depth overview of requirements as they were known at that time. Additionally, the document provided the means by which the developers could convey their understandings of the project's functional and non-functional requirements.

Within the requirements specification document, we sought to construct a more extensive list of requirements for the Al-Sawaf Establishment's proposed DSS cost estimator. Requirements identified were further defined by management within ATE. Additional requirements were inferred from research of similar systems and personal observations. Some of those additional requirements included general constraints, resource utilization, and serviceability.

Primary users of the application would be employees and management of ATE. To a large extent, these end-users have little experience with online applications. Accordingly, the application would need to be as end-user friendly as possible. The determination of a product cost estimate up to this point was created by filling out forms and using calculators. Clearly, this application should make the task of producing reliable calculations much easier. The introduction of an online database would eliminate storage problems associated with paper copies. The DSS application used MySQL as the database which was already located on ATE's existing server.

Performance requirements included the necessity of an internet connection for the web-based application. Any computer capable of running Internet Explorer 6 (or later), Mozilla Firefox, Apple Safari or an equivalent web browsing software would be sufficient to access the application.

Non-functional attributes were addressed such as: security, binary compatibility, reliability, maintainability, extensibility, reusability, and application affinity/compatibility. To ensure security, authorized personnel would be validated through a login page. Authorized users other than identified management would not have access to the back-end code. Forms developed should be coded in a manner to prevent users from uploading malicious code onto ATE's server. The code should be well documented so that other programmers could easily make changes or upgrades. Extensibility should allow for future submissions and should allow management to keep files for an extended period of time.

Operational scenarios were examined to include "best," "normal," and "worst" case performances (Turban, 2007). These were developed as pragmatically as possible given the constraints of the project as outlined in the Requirements Specification document.

PROJECT CODING

The process of coding the DSS tool to calculate a final selling price for a specific order was divided into two sub-processes. The first was between the vendor and ATE and the second was between ATE and the client requesting a quote. The direction of these sub processes is as follows:

- The client contacts ATE requesting a quote for an identified product with a specified quantity.
- ATE contacts the product vendor, verifies the price, confirms how long the price is valid, and the method of shipping.

- ATE then issues a quotation that has the final price for the client.
- ATE forwards a written quote to the client, and if the client is in agreement with the terms, the client in turn places a purchase order with ATE.
- ATE then requests the items from the supplier who delivers them directly to ATE's warehouse. Depending upon the contractual agreement between the client and ATE, the products will be delivered to or picked up by the client.

As stated earlier, one purpose of this web-based DSS tool is to make the necessary calculations for ATE by replacing the "paper and calculator" based system that is currently in place. Assuming that the client has requested the quote and ATE has contacted the supplier, that quote should carry the following information:

1. Client Request Reference Number + Date of Client Request (indicated on contract to customer)
2. ATE's Quotation Reference Number for further identification (indicated on contract to customer)
3. Item Catalog Number (indicated on contract to customer)
4. Item Description
5. Quantity
6. Unit Price
7. Total Price
8. Discount (if applicable)
9. Delivery Terms & Conditions
10. Payment Terms & Conditions
11. Quotation Validation

OUTPUT

The following is an example of the application created using actual company data including screen shots to illustrate how the DSS application works. Initiating the sales process or responding to a request for a quote begins with user login illustrated in Figure 1. A salesperson/employee logs in with their username and password previously registered in the MySQL Database.

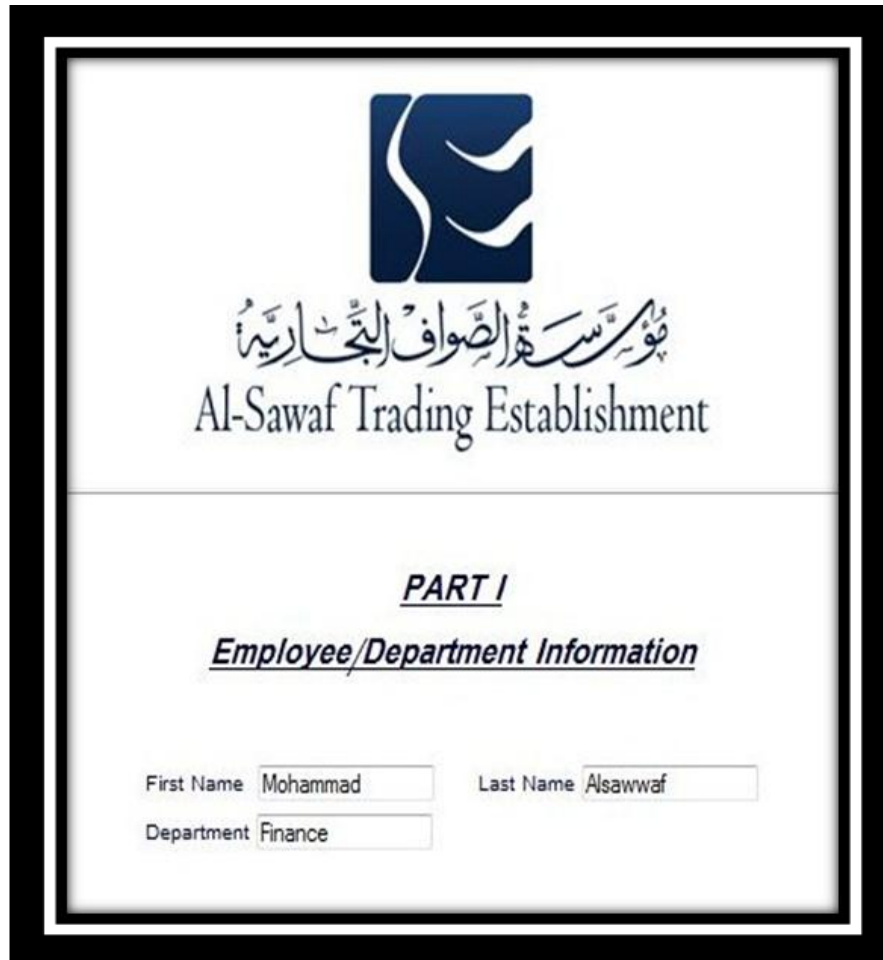



Figure 1

The application is divided into two main sections: the Information and Parameters Section, and the Results Section. The first section is not shown to the client and is used mainly to input the necessary parameters to calculate the final price of a product. It is also stored in the company's database for future reference. This first section is divided into three separate screens as illustrated below. The second section is the Results Section which presents the information necessary to provide an accurate quotation to the customer.

Information and Parameters Section

The first screen of this section, shown in Figure 2, asks for more specific information from the end-user than did the initial login screen. It is the personal information of the sales person or the employee who is making the quote to the client and is used as an electronic signature of the sales person/employee.




 مؤسسة الصواف للتجارة
 Al-Sawaf Trading Establishment

PART I

Employee/Department Information

First Name Last Name
 Department

Figure 2

The next data supplied into the application is critical to determine a quote and maintain a desired level of profitability. As indicated in Figure 3, the salesperson/employee must enter the “Product Name,” “Supplier Name,” “Price Per Item,” “Currency,” and “Currency Exchange Rate.” One of the critical calculations at this point for ATE is the type of currency and the current exchange rate of currencies being used. In this example, Otto Holding is located in Peoples Republic of China and only accepts payments in US dollars. Accordingly, ATE must also calculate the exchange rate of Saudi riyals into US dollars in order to make the purchase price available to the customer. Currency exchange rates at the time of the transaction are referenced from local banks engaging in international commerce. The cost of currency conversion and bank charges for transfer of funds must also be included. On occasion a supplier may offer a discount. If that is the case, the data is shown in the section “Price After Discount.” Depending on the size and types of items ordered, different container sizes are used. In this example, a container of 40FT is specified. This may seem large, but the container could also include other items being shipped. There is a total of one container being used with 378 wheel chairs at a cost of \$41.50 each in US currency being shipped FOB.

It is critical to identify the correct “Shipping Option.” This along with currency conversion requirements determines whether or not a product cost estimate is quoted correctly by ATE. There are three shipping options that the user may select and are defined as follows:

- **FOB = Freight on Board**
 - If the manufacturer says : **THE COST PRICE** covers **FOB**, this means the cost price submitted by the manufacturer “**Will Only** cover loading the goods at the sea port used by the manufacturer and the manufacturer is **not responsible** for any **Shipping Charges or Insurance Charges.**”
- **C&F = Cost & Freight**
 - If the Manufacturer says : **THE COST PRICE** covers **C&F**, this means the cost price submitted by the manufacturer “**Will** cover loading the goods at the sea port used by the manufacturer **and Shipping Charges** from manufacturer’s port to the destination port but is **not responsible for Insurance.**”
- **CIF = Cost Insurance and Freight**
 - If the Manufacturer says : **THE COST PRICE** covers **CIF**, this means the cost price submitted by the manufacturer “**Will** cover loading the goods at the sea port used by the manufacturer, **Shipping Charges** from the manufacturer’s port to the destination port, **and Insurance Charges.**”

PART II
Product and Quote Information

Product Name:	<input type="text" value="Wheel chair"/>
Supplier Name:	<input type="text" value="Otto Holding. China"/>
Product Price/Piece:	<input type="text" value="41.50"/>
Currency:	<input type="text" value="USD"/> ▼
Currency Exchange Rate:	<input type="text" value="3.75"/>
Price after discount:	<input type="text" value="41.50"/>
Container Size:	<input type="text" value="40FT"/> ▼
Total Number of Containers:	<input type="text" value="1"/>
Total Quantity:	<input type="text" value="378"/>
Shipping Option:	CIF <input type="radio"/> C&F <input type="radio"/> FOB <input checked="" type="radio"/>

Figure 3

The correct calculation of currency exchange rates and costs included with shipping options is critical to providing correct quotes to customers. Each is internally critical as well as being essential interdependently. Specifically, if payment is required by ATE for shipping and insurance via a currency other than Saudi riyals, this said payment exchange rate can have a direct effect on marginal profitability as well. As noted in the above example, ATE would be responsible for paying shipping and insurance.

The third screen of this section, shown in Figure 4, indicates variables included with Customs and Shipping Charges such as: “Shipping Charges,” “Agents Working for Customs,” “Total Costs for Uploading and Downloading Goods,” and whether “Cartons” or “Pallets” are being delivered. This screen also includes charges for delivery of the shipment from a port in Saudi Arabia to ATE’s warehouse; “Labour Charges” associated with the delivery, and estimated “Miscellaneous Charges.” Insurance is a constant 1% of the total price. It is calculated in the background with no need for the sales person/employee input. This calculation plus shipping charges is included in the “Total Selling Price Per Piece” in Saudi riyals as shown in Figure 5, the “Results” screen.

The screenshot shows a web form titled "PART III Customs and Shipping Charges". The form contains several input fields and checkboxes. The fields are: "Shipping Charges:" with a value of 2300; "Agents working for Custom:" with a value of 150; "Total Cost for uploading & downloading goods:" with a value of 400; "Transportation Charges(Port to Warehouse):" with a value of 250; "Labour Charges(Truck to Warehouse):" with a value of 100; and "Miscellaneous Charges:" with a value of 200. There are two checkboxes: "Cartons" which is checked, and "Pallets" which is unchecked. At the bottom of the form are two buttons: "submit" and "Clear Form".

Field	Value
Shipping Charges:	2300
Agents working for Custom:	150
Total Cost for uploading & downloading goods:	400
Transportation Charges(Port to Warehouse):	250
Labour Charges(Truck to Warehouse):	100
Miscellaneous Charges:	200

Figure 4

After completing this section, the salesperson/employee submits the form and the background code makes the necessary calculations.

Results Section

The final screen displayed in the process shows end-user results. As shown in Figure 5, the application displays a results page indicating the required information to complete the transaction. This information is used to produce a contract between ATE and the client. The contract with the required information is printed and forwarded to the client with ATE's wax seal to be returned with the client's endorsement.

The total selling price for the product in SR	76519.98
The total quantity	378
The total selling Price Per Piece in SR	202.43

Figure 5

RESULTS/IMPLICATIONS

The ATE application was tested and retested for validity and reliability to produce correct cost estimate calculations. It has been implemented by ATE and is producing calculations necessary to maintain specified levels of competitive profitability.

Some of the implications realized in the completion of this project included:

- Providing users with cost estimates with increased accuracy and in a timelier manner compared to the previous system,
- ATE is more competitive in the marketplace,

- An effective DSS tool was produced and delivered in accordance with the scheduled needs of ATE by following a systematic software development methodology,
- Extensive documentation that assists the staff in performing intermittent review and maintenance more effectively,
- Access to code documentation allows maintenance programmers to update the application reflective of changing market conditions, and
- Extensive documentation will allow for the application to be included in a larger and more complex development effort in the future.

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- [6] Mrs. Ruth Derrick, (Instructor of English, Radford University, Radford, VA). We would like to express our thanks for her editorial review.

FROM STALE TO SPICY: A REMARKABLE RECOVERY

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ABSTRACT

Once the world took its first proverbial bite into Apple Inc. in the late 1970s, people liked what they tasted and wanted more. Today, they still can't get enough of Apple, a company that has nothing to do with fruit although with every technology product or service it releases conveys the fresh, healthy, appetizing image that inspired the company from its origin. Apple, which started out in computers and over the years has branched out to revolutionize newer industries such as mobile phones and music devices, is a shining example of a company with exceptional leadership, marketing and research and development, which has been remarkably successful at managing its relationships with suppliers, partners, customers, the media and even hackers over the years. The company was not always so successful, but it learned from the years when it had gone stale. Today, Apple and its products are more appetizing than ever.

ORGANIZATION BACKGROUND

Apple Inc. was founded in 1976 by Steve Jobs and Steve Wozniak. The company began as a computer company, under the name Apple Computer Inc., but over the years its technology products expanded far beyond just computers, so the company removed "Computer" from its name. The reason for the name Apple for a computer company came from the company's effort to convey a "fresh attitude, something new and healthy" (Kendall, 1994, p. 31).

Apple still makes computers, but it is also well-known for its portable music players called iPods, as well as its iTunes service where customers can buy music, videos and more. In addition, the company makes mobile phones called iPhones, and it recently released the iPad, a device that falls in a new category somewhere between a laptop, a tablet computer, and electronic book reader and an iPhone. Today, Apple has about 34,300 employees. It is based in Cupertino, Calif., and as of September 2009, it had 273 retail stores, including 217 stores in the U.S. and 56 international stores. Key people at Apple include co-founder and chief executive Steve Jobs, chief financial officer Peter Oppenheimer, and chief operating officer Timothy Cook. In addition, Jonathan Ive, the company's senior vice president of industrial design, is well known for having designed such aesthetically pleasing products as iMac computers and the iPhone.

Apple has been extremely successful over the years as its creation of innovative products that have a near-cult following has helped it turn in remarkable sales and extremely strong gross margin. In fiscal 2009, which ended in September 2009, the company's total annual revenue reached \$42.91 billion. That has increased a lot over just four years. In fiscal 2006, the company's annual revenue clocked in at \$19.32 billion. Apple's gross profit margins are among the strongest of any company. In fiscal 2009, the company posted a 40.1% margin, up from 29% in 2006. Apple's net income has followed a similar trend, with the company earnings \$8.24 billion in fiscal 2009, more than quadruple that nearly \$2 billion net income Apple had in fiscal 2006 (see chart in appendix, page 18). Apple's stock has also climbed over the past year.

Such growth over the past four years despite the financial crisis that ripped through the economy in 2008 and early 2009 is truly remarkable and speaks to the ability of Apple to appeal to customers regardless of their economic state. This may be surprising, as Apple's products are priced at premiums to its competitors' offerings, but it is really an indication that customers consider the premium price worth it. In addition, Apple tends to offer its products at tiered price levels, so the company has the ability to appeal to the more affluent with its higher-priced offerings while the bargain hunters enjoy the low-end models Apple offers.

Among Apple's strategies, the company is focused on marketing its products as being hip, cool, and on the cutting-edge as well as high quality and worth the premium pricing. Apple tries to develop innovative products that its customers would consider game-changers – things they never would have imagined, but can't live without once they try them. The strategy has worked so far with Apple's computers as well as its iPod and iPhone. And while sales of the iPad are still in the early stages, indications are that the product will be just as successful as the others, if not more so.

SETTING THE STAGE

Apple's success in recent years jump-started with the release of the iPod and reinvention of the Macintosh. The iPod music player captured the interest of the youth which eventually began to look at Apple's flagship Macintosh computer. Creating an improved Mac was the result of Steve Jobs coming back on board with the company and envisioning the need for a change. Through his controlling nature, Steve Jobs kept a close eye on all aspects of new product development which paid off for the company. The culture of the company was created based on Steve Jobs's own behaviors. Apple can now truly state with confidence that the products it produces are better than the competition. The company strives for high quality design principles to ensure each new product has an enhanced visual aspect.

CASE DESCRIPTION

Among the key factors that affect Apple's business, key internal matters to consider include the leadership provided by Chief Executive Steve Jobs, the marketing generated by the company that has led to its unique brand image, and the research and development that are instrumental in the creation of each of the company's products and services. External factors, meanwhile, include Apple's competitors, its partners, its suppliers, its customers, the economy, the media and hackers.

Internal Factor 1:

Apple Co-founder and CEO Steve Jobs

Steve Jobs, Apple's co-founder and chief executive, is often considered synonymous with Apple and is even considered to have celebrity status. He is a clear influence on everything the company does, and is credited with much of Apple's success for the way he has directed the company with a distinct vision. In turn, Jobs was once described by a past coworker as having "the power of vision that is almost frightening. When Steve believes in something, the power of that vision can literally sweep aside any objections or problems. "They just cease to exist" (Imbimbo, 2009, p. 70). Whether it is naming a computer, coming up with the name Apple, or creating a bold, strategic plan for his next gizmo, Jobs seems to think in an unparalleled way and is considered one of the most valuable and important people in the corporate world today.

Jobs is highly revered in the business world for his clear sense of vision and his confidence in his gut feeling, which are true leadership traits. While Jobs is not afraid to experiment and take risks, he will not compromise on quality. He is considered a true innovator, always looking to revolutionize the digital

world with products that are not only functionally unique, entertaining and useful, but that are also aesthetically and ergonomically pleasing.

Jobs created Apple with his friend Steve Wozniak in the garage of his parents' home. Today the company stands with more than 30,000 employees and with quarterly revenues in the billions. It was not one easy path, but part of the reason the company has gotten to where it is today is because with every mistake the company made, Jobs recognized it, learned from it, and made sure it would not be repeated in the future. Among the company's early failures: the Apple III and the Lisa, both of which suffered from major oversights in what the products did and whether they would satisfy their targeted audiences. But the Macintosh helped rectify those mistakes, and Jobs was considered one of the biggest influences on the Macintosh's ascent to the market.

"The Macintosh never would have happened without him, in anything like the form it did. Other individuals are responsible for the actual create work, but Steve's vision, passion for excellence, and sheer strength of will, not to mention his awesome powers of persuasion, drove the team to meet or exceed the impossible standards we set for ourselves," said Apple engineer Andy Hertzfeld (Imbimbo, 2009, p. 79). However, Jobs left not long after the Macintosh's launch due to creative differences he had with then-chief executive John Sculley. In his time away from Apple, Jobs started a company called Next and also bought what became Pixar and is now a part of Disney.

In the meantime, Apple made a series of missteps and eventually brought Jobs back through an acquisition of Next's software. As Gil Amelio, Apple's chief executive at the time said, "I am not buying this software, I am buying Steve" (Imbimbo, 2009, p. 94). Steve Wozniak in a recent book said the return of Jobs to Apple was exactly what the company needed, due to Jobs's strong passion, unique vision and commitment to excellence. Apple had gone through a rough period during which its very existence was threatened, but Jobs came charging back with marketing leadership and charisma that restored consumers' and investors' loyalty. Eventually, he was named to the company's helm and in his second time around at Apple, Jobs made a number of changes that showed he had grown over the years and was even ready to become strategic partners with companies that had once been its arch rivals.

In recent years, in addition to Jobs's constant commitment to creating the next best thing, he faced a personal battle against pancreatic cancer. When investors and customers saw Jobs's weight dwindle and began to worry about his health, they also grew concerned about the future of Apple, as Jobs's leadership there is considered part and parcel to the company's success. Fortunately for Jobs and the company, Jobs recovered fully although there was a period when he was unable to be directly involved in the company's day-to-day operations. This served as a litmus test for Apple to see if the company could survive without him.

What comes to consumers' minds when they think of Apple is innovation, creativity, and hip and cool features. The person behind the brand image is Steve Jobs, a man who may dress simply in a black turtleneck and jeans at most events but whose influence and impact on Apple and the world of technology are immeasurable. To this day it is clear that Jobs continues to be passionate about what he does for Apple and its customers, a drive well articulated in a speech Jobs once gave at Stanford University. Jobs said, "you've got to find what you love and I'm convinced that the only thing that kept me going was that I loved what I did" (Stanford Report, 2005).

Internal Factor 2: Marketing and its Impact on Apple's Success

A marketing department is responsible for acquiring and retaining customers for products and services by delivering desired value. The department makes this possible by identifying and creating needs to cater to

consumers effectively and efficiently. Apple, through the leadership of Steve Jobs, has executed this task brilliantly throughout the history of the company. Jobs recognized the importance of marketing even in the early years of growing the company. For example, when Steve introduced the Macintosh computer in January 1984, he programmed it to tell a joke: “Never trust a computer you can’t lift,” the machine said. In turn, Jobs “gave the Mac a personality—cute and funny—and made people think differently about how this machine could transform their lives” (Imbimbo, 2009, p.79). This simple joke signified Apple’s ability to stand out in the crowd of competitors by being different.

Among the many success stories of Apple’s marketing department, its marketing for the iPhone product, launched in 2007, really stands out. “Jobs’ announcement was an example of the intelligent use of trade shows and Apple’s experience with generating press coverage and buzz about new products through them” (Mickalowski, 2008, p.1). In doing so, Apple leveraged its previous success of the iPod to jump into a new market. Positioning the device as a wireless smart phone with a built-in iPod gave the company a natural direction for consumers who already owned and loved the iPod. In addition, the device had a strong advantage over the competition due to its innovative touch-screen technology integrated virtual keyboard. Before this, consumers were used to smart phones with a physical keyboard and smaller screens.

In turn, Apple’s marketing of the iPhone was seen as exemplifying “Apple’s knack for creating excitement about products among its fiercely loyal customer base, who keep attention focused on the company, and then justify the hype by delivering a high-quality, desirable product.” (Mickalowski, 2008, p.6). And it paid off, as seen through the sales of the iPhone on its first weekend available. Apple estimated 500,000 units were sold during that initial. In addition, its marketing was recognized by *Advertising Age*, which in 2007 selected Apple as a runner-up for the annual Marketer of the Year award. *Advertising Age* is an influential periodical dedicated to advertising, and for a technology-oriented company to be recognized for its marketing efforts is a major achievement.

The reasons for Apple’s marketing success are numerous. Many point to Apple’s ability to control the media by using them to aid their advertising goals. When new products are unveiled, no other company has received as much attention as Apple. This year, Apple released a new product called the iPad. Excitement was stirring about the product long before its introduction, as Apple leaked enough details about it to the press to get them writing about it but left out enough detail that it would keep everyone wondering and build up the hype even more. As soon as Jobs introduced the product to the public, reporters, journalists and bloggers wrote prosaically about the device. The iPad instantly received a lot of what essentially became free advertising. It could have never released a single ad for the iPad and yet the product still became widely known due to the excitement over it in the press and the blogosphere. That excitement helped sell 300,000 iPad devices in the product’s first day on the shelves.

As for the actual advertisements that appear for Apple products, they too are a clear reflection of the company’s marketing prowess. A prime example is the Apple MAC computer vs. Microsoft Windows PC television ad in which the young actor Justin Long portrays a MAC while an older man defends a Windows PC. This advertisement scheme single-handedly gave the public a new outlook on Apple, adding to the public’s perception of Apple’s products being fun and cool.

Internal Factor 3:

Apple’s Research and Development – A Small Budget But Big Impact

One of Apple’s most valuable characteristics is the emphasis the company places on research and development. It is crucial for a company such as Apple, which brands itself as a creative mastermind and the developer of game-changing and life-changing technology and devices, to make ample investment in the research and development that is necessary to lead to such products and services. Otherwise, there

would be nowhere for each of its “next big things” to incubate, become cultivated, and eventually come to life.

Nevertheless, Apple knows how to spend its R&D money wisely. It actually spent far less than competitors back in the early 1980s in creating one of its biggest game-changing products – the Macintosh computer. That’s because while the company focuses on investing in new ideas, it also tends to consider how to do new things with some products and technologies that have already been around. “Where Apple scored big was in combining existing but underutilized technologies—such as the mouse, the full-page monitor and the graphic user interface (which were invented by Xerox Corp. but not commercialized)—in a cleverly designed and consumer-friendly package” (Gibson, 2009, p. 26).

Today, Apple still manages to maintain a much smaller R&D budget than its competitors. It has just a 5% share of the computer market and just a fraction of Microsoft’s \$6 billion annual R&D budget, and yet its personal computer operating system is arguably considered the most advanced. Apple has been able to maintain a smaller budget because the core software code behind its operating system came from the public domain. “Essentially, Apple layers its own proprietary ‘skin’ over this core—the interface, the Finder and other components that make the operating system so cool and easy to use. If Apple had gone the route of developing Macintosh, iPod or MAC OS X completely on its own, entirely from scratch, the costs would have been astronomical” (Gibson, 2009, p. 27).

Where Apple puts most of its R&D investments are the areas where the company can really set itself apart. For example, rather than focusing just on software or just on hardware, as many other technology companies have, Apple often finds ways to make software and hardware that work together so symbiotically, competitors’ products seem to be no match. In a recent memoir, Apple co-founder Steve Wozniak says the very fact that Apple worked on both together is one of its biggest reasons for success. Apple’s computers historically worked better than IBM-compatible PCs because of this, and the combination of the iTunes software with iPod hardware followed a similar trend, co-founder Steve Wozniak noted in a recent book (2007). “It’s only because Apple supplied both sides of the equation—the hardware and the software—that it was able to create a product as great as this...” (p. 299).

In addition, Apple puts a great deal of focus on design, ensuring each new product looks as unique as possible yet is recognizable as a part of the Apple brand. The iPhone, for example, initially looked “like nothing else. It took no cues from category norms” (Murphy, 2008, p.6). Since then, many competitors have created mobile phones that mimic the look of the iPhone, but when it was first released, the design of the device was unlike any other.

Apple also puts a great deal of emphasis on the little details other companies often overlook. As reported by Scalon (2007), one of the secrets of Apple’s success is its obsession with the small stuff – cords and ear buds, for example. Every component is held to the same exacting design standards. In turn, these little things have become a big part of Apple’s image. The white cords and earbuds and simple, sleek designs of its products are important aspects that help consumers recognize when a product is made by Apple, and they add to their allure.

Because Apple’s design is so iconic, its designer, Jonathan Ive, has become almost as much of a celebrity as Steve Jobs himself. Ive is considered the mastermind behind the look of the iMacs as well as the iPods that have been largely credited with helping Apple turnaround from the slump it had seen in late 1980s and early 1990s. Among the things Ive did to find just the right unique recipe for the gum-drop colors of the iMacs, he and his team actually consulted with experts in the confectionary industry to learn more about the colors before they experimented with them in plastics (Harris, 2009). However, unique wasn’t the only thing Apple was going for with its design. It was also looking to make its products seem more approachable; something the average person could pick up and feel comfortable trying without reading a

manual. “A lot of people at that time were really nervous around computers so one of our clear goals was how we could make the product more accessible, for it not to be intimidating,” Ive said (Harris, 2009, p.60).

External Factor 1:

How Competitors Aid Apple's Product-Improvement Efforts

Because Apple's products cross into so many spaces with their variety of functions, one might say the company has a great number of competitors. But the one that would be considered its closest foe over time is Microsoft, which Apple has had a rivalry with pretty much from the time it was created. However, while the companies are still competitors, they now actually work together as partners in some ways in a clear indication of how much the competitive landscape in the industry has changed. A quick summary of the changing relationship between Apple and Microsoft goes as follows: Microsoft in 1981 developed Windows, “an operating system that mimicked the look and feel of a Mac. In 1994, Apple unsuccessfully sued Microsoft for copying the look of the Mac. By 1997, Steve and Gates were working cooperatively. Microsoft partnered with Apple to develop software for the new Macs, which helped Apple's resurgence” (Imbimbo, 2009, p.93).

Apple and Microsoft have helped each other directly and indirectly create better products with each Operating System release. Many would argue that each company copies core features from the other's systems. More recently, one may compare Apple's graphical user interface engine which is called Expose to Microsoft's Aero Peek. Both display friendly graphical environments and contain similar usability features. Other examples include a comparison between Apple iWork and Microsoft Office or even the iTunes media player and Windows Media Player. Even Apple's Front Row application can be compared to Windows Media Center. And it isn't just the big software packages offered by the companies that tend to mimic each other; even small features are copied through functionality and implementation. A prime example is the shortcut key combination of Cmd-Tab on a Mac being the same as Alt-Tab in Windows.

Regardless of whether these ideas were copied or simply a part of the common evolution of computers over time, both Apple and Microsoft have expanded their offerings as a result of the competitive landscape in the industry. If a company in the technology industry were to stand still not improving, it would only open the doors for other companies to enter the industry more easily and take a piece of the market share.

A more recent rivalry has been developing between Apple and Google, a relationship that also has helped the companies advance the state of the cell phone industry as they continue to challenge each other. Without question, Apple's iPhone revolutionized the mobile industry but also opened up opportunities for other companies to create similar products. Google released the Android mobile operating system that is considered a formidable competitor to the operating system on the iPhone, especially because it has the ability to run multiple applications at the same time. This feature has been missing from every iPhone release. To counter this feature Apple recently announced plans to add this feature in its new iPhone coming out in summer 2010. The fact that Apple is making sure its products now have this coveted feature shows how Apple quickly recognizes competitive threats and reacts quickly to ensure that its customers stay happy and that it can continue to win new customers.

In turn, increasing competition in the technology and consumer electronics industries plays a big role in shaping what Apple decides to create and release. Competition is thus worthy of credit for Apple's vast improvements in its products over the years. Without it, Apple might not have gone quite as far as it has to stay on the cutting edge. It is this edge that allows the company to offer premium products at a premium price.

External Factor 2:

Apple's Network of Partners –Making the Most out of Relationships

The formation and maintenance of mutually beneficial partnerships is very important to survival in the technology industry, as there are so many areas for specialization that it is nearly impossible for one company to rely solely on itself and not work with partners. Those companies that do tend to struggle as they waste far too much time, money and energy trying to work on things other companies are already masters at. As a result, Apple has recognized the needs for it to nurture positive relationship with other companies that are at the top of their fields. Among the company's key partners, it has AT&T providing the mobile phone service for its iPhones, while it also works with Microsoft, as previously mentioned, so that the companies can leverage the best of each of their worlds to give consumers what they want.

In Apple's relationship with AT&T, only three executives at AT&T had seen the iPhone through its development stages, and AT&T gave up nearly all control (Mickalowski, 2008). Such an agreement gave Apple the flexibility to develop its product on its own terms and keep its features under tight wraps. In addition, it meant Apple could focus on producing a superior product and didn't have to worry about network issues, as that was under AT&T's domain. Apple was even able to strike an unusual deal to split the revenue with AT&T. Meanwhile, it was a big benefit to AT&T because iPhone customers would need to commit to a two-year wireless agreement with AT&T, which prompted those customers who wanted the iPhone but weren't already AT&T customers to make the switch to AT&T. Still, there are some holdouts who are loyal to Verizon and are hoping that one day the iPhone will also work with Verizon service.

Apple's relationship with Microsoft is not only one as a competitor but also now as a partner, as they were able to overcome their bitter past and work jointly to produce Microsoft products for Apple's operating system (*Strategic Direction*, 2008). In return, Apple made the popular iTunes music catalogue available for Windows users. The relationship between Microsoft and Apple is an excellent example of the fact that in business, there often cannot be clear rivals or friends; rather, alliances are made if they are beneficial to both parties, and it's as simple as that.

However, not every partnership Apple has been in has been a positive one. For example, its partnership with International Business Machines soured because IBM started to give less attention to Apple as it accounted for a smaller percentage of its overall revenue. Still, Apple was in a situation where it needed better processors, so it looked to other providers and ended up forging a new partnership with Intel, even managing to get Intel to agree to special terms. For example, computer manufacturers who use Intel chips typically must display Intel's sticker on their computers, but Apple was able to keep its computers free of Intel stickers under their deal.

Other companies Apple has partnered with include Viacom, Disney, Google and Yahoo, all of which were strategically selected to bring Internet features to the iPhone (Mickalowski, 2008). Apple's relationship with Google is particularly interesting, as Apple uses Google as its default search engine, but as Google continues to branch out from Internet searches to other technologies such as mobile phones, the companies are becoming bigger competitors for one another, as previously mentioned. For the iPod and iTunes, Apple reached a deal with record companies in April 2003, which enabled the launch of the iTunes Music store with 200,000 songs in its library. Within a week, more than a million songs were sold (Imbimbo, 2009). The deal was remarkable in that many others had previously tried to get music companies to agree to have their music sold similarly, but it was only CEO Steve Jobs who was able to successfully negotiate a deal with the music-recording industry.

External Factor 3:

Apple's Suppliers – Working Together to Build Game-Changing Products

As creative as Apple's designs and ideas are, the company must rely on the latest technology and available parts to bring them to life. The success of Apple's products and its continued ability to provide them is therefore contingent on the company's relationship with suppliers who can get the company components that are both cutting-edge and reliable. By leaning on these companies to provide the nuts and bolts of its products, Apple can then devote more of its time and resources to the design, software and marketing that are to credit for its cult-like following. Part of the reason behind Apple's following is because Apple has shown great prowess in taking ordinary technology components that are readily available on the market and putting them together in such a way that others might have never imagined. As noted by Gibson (2009), "none of the iPod's essential components are unique and can almost be bought off the shelf." However, "what made iPod a hit was the way Apple infused the device with its classic attributes—user-friendliness, cool design and iconic brand—and then linked it to the iTunes business model" (p. 27).

The very fact that Apple does rely on available parts from a wide variety of global suppliers is part of what helps it focus on what it does best. The Apple iPod, for example, is designed and marketed by Apple, but it is actually assembled by Taiwanese manufacturers in China, and includes parts from suppliers in Japan and Korea as well as the U.S. After Portelligent Inc. dismantled the 30GB iPod that went on sale in October 2005, it found the device's hard drive was from Toshiba in Japan while its video and multimedia processor came from Broadcom in the U.S., it was assembled by Inventec in Taiwan, and its 32MB of mobile SDRAM memory came from Samsung in Korea (Linden, 2009). The relationship between Apple and its suppliers is mutually beneficial, as "the suppliers are able to benefit through the revenue generated by increased business, and Apple is freed from running complicated, labor-intensive manufacturing operations" (Mickalowski, 2008, p.284). However, the suppliers can at times get disgruntled by Apple's secrecy when they are trying to assess and provide what the company wants from their parts. "Apple is notoriously perfectionist and demands instant answers when parts or projects fail to live up to expectations. A frustrating tendency to limit the amount of information given to partners and suppliers can hardly help in this or other respects" (Imbimbo, 2009, p. 15).

Nevertheless, suppliers by and large seem happy to work with Apple and take pride in supplying the parts to some of the most pivotal technology products and devices. Investors often pay close attention to what companies are supplying Apple's devices, and the shares of those suppliers tend to benefit. "After all, those associated with a company of Apple's stature are likely to be perceived as pretty cool themselves" (Imbimbo, 2009, p.15).

External Factor 4:

Apple's Customers and Efforts to Meet their Needs

Customers' needs and wants have undergone a dramatic change over the past few decades, with much of Apple's technology helping shape that and then serving as a response to it. When the Apple II was introduced in 1977, people could not imagine a computer at home and had doubts about the use or utility of personal computers (Kendall, 1994, p.41). Computers at that time were only associated with banks and big businesses. However, over time people began to realize how computers could make their lives easier, not only at work but also at home, especially when it came to keeping track of personal finances. And many were pleasantly surprised that they did not even have to memorize long commands or think through complex steps to use computers. In the years that have followed, the advent of the Internet acted as an additional catalyst for changing needs and wants among customers, to the effect that today, technology is an essential component of everyday life.

While consumer spending directly accounts for just 10% of total information technology spending, it is an important factor (Smith, 2010). That's because consumer confidence helps drive consumer spending

across the economy which in turn leads to improved business confidence and therefore drives business capital spending. In addition, as PC penetration in the home increases, businesses must invest more in their IT infrastructure to handle increasing demand for e-commerce transactions and other high-tech services. Changes in consumer behavior therefore can have a huge impact on corporations and how much IT spending they decide to do.

Apple's iPod has had a huge impact on consumer needs and wants. It is safe to say by now, with iPods so ubiquitous, that Apple was able to succeed in making iPod a necessity. This is because Apple was able to figure out from competitors' failures what it was that consumers really wanted, and then it was able to apply that to create something consumers fell so in love with it they decided they now need it. By 2005, Apple held seventy-five percent of a more than \$4 billion market for digital music players (Peterson, 2007). In addition, the iPhone is considered a prime example of the ways technology and consumer needs and wants have been feeding off of each other in that "it is explicitly conceived as an intervention into the styles and genre of contemporary culture – notably mobile phone cultures, Internet cultures, and the broader scenes of digital culture" (Goggin, 2009, p.231).

Apple's recently released iPad is now its attempt to help change the habits and lives of those who haven't been quite as affected by technology – the older generations. "Put simply, it's aimed at your parents, your grandparents, your friends who aren't into technology as much as you are – in fact; it's aimed at anyone who doesn't need the power of a regular PC or Mac" (Furfie, 2010, p.35). The device is known to be particularly user-friendly so that this generation can more easily adjust. Nevertheless, in a world of ever-changing consumer needs, some needs and wants do stay the same – the need for reliable service, a quality product and the want for it to look and feel pleasing and cool. These are things Apple targets directly in its marketing, as previously mentioned, and it's important for the company to continue appealing to these static needs while it also works to satisfy and create customers' new needs.

CONCLUSION

While Apple certainly has had its rough patches over the years, it is a company that has had remarkable success in creating products and services that not only break the mold and become game-changers, but also go from consumers' wants to their needs, and bring in a good amount of money too. Apple's evolution from a small, garage-run business to the technological powerhouse that it is today is a testament to the company's ability to do business in any economy and to keep using innovation to give customers what they want. In the meantime, the company knows how to use its marketing to work the media and keep its image as positive as ever. Apple has already completely changed the way we use computers, the way we listen to music and more. It will certainly be interesting to see what else the company has in store.

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EXAMINING CRISIS READINESS: AN ANALYSIS OF MANAGERS IN THE RETAIL INDUSTRY

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ABSTRACT

This paper addresses the factors—organizational capabilities, environmental uncertainty, and generic strategy—that contribute to an organization’s crisis readiness among retailers in the United States. A survey of 277 retail professionals suggested an association between crisis readiness and organizational capabilities. Crisis readiness was linked to technological uncertainty, but not market or competitive uncertainty. Organizations pursuing a differentiation strategy demonstrated greater crisis readiness than those emphasizing cost leadership.

INTRODUCTION

What strategic factors influence an organization’s crisis readiness? The fact that some organizations are more prepared for a crisis than others has been apparent in the crisis management literature for many years. Pearson and Mitroff (1993) were among the first organizational researchers to address this conundrum, suggesting that many crises were human-induced and as such, could be avoided in many instances. Indeed, since 1994, the Institute for Crisis Management has been tracking crises sources and has concluded that the majority of organizational crises are human-induced. In a recent study, the Institute found that 51% of all reported crises originated with management while 31% were caused by employees (Institute for Crisis Management, 2009). Examples of human-induced crises include corporate scandals, workplace violence, sexual harassment, workplace accidents, and white-collar crime.

Much can be learned in preventing these types of crises and promoting crisis readiness. Implementing ethical reforms in the organization is one such measure (Crandall, Parnell, & Spillan, 2010). What is most disturbing about human-induced crises is that many of them need not occur at all. Unlike environmentally-induced crises such as hurricanes, snowstorms, or other natural disasters, human-induced crises may be triggered by top management action or inaction (Carroll & Buchholtz, 2003; Hartley, 1993). Fortunately, a wealth of literature is growing that is addressing the proliferation of human-induced crises and how they can be prevented and managed.

What is less developed in the crisis management literature is an analysis of the strategic factors that contribute to an organization’s crisis readiness. In this paper, we define crisis readiness as “the readiness to cope with the uncertainty caused by a crisis” (Rousaki & Alcott 2007: 28). Such a construct is relatively new in the literature and offers a way to assess an organization’s proactive posture in preparing for future crisis events regardless of origin. The factors that influence crisis readiness can offer insights on how organizations survey their internal and external environments in preparation for prospective unfortunate events.

In this paper, we examine the internal and external factors that influence crisis readiness. We take a strategic management perspective in that we seek to understand a firm’s organizational capabilities, environmental uncertainties, and generic strategies and how they influence its crisis readiness. We begin with an overview of the crisis readiness concept, the posture of preparation that organizations must take to

anticipate crisis events. We then consider three strategic areas in every organization's strategic planning process: Capabilities, environmental uncertainty, and competitive strategy. We hypothesize that these three areas have a direct influence on its crisis readiness tendencies. Finally, we test our assertions and offer implications for researchers and managers in relation to our findings.

CRISIS READINESS

Crisis readiness is a sub-area of the broader discipline of crisis management. A crisis refers to an unpredictable event that can threaten the organization and its stakeholders. Moreover, it can seriously threaten the organization's performance (Coombs, 2007). As such, crisis events are low-probability, high-impact events that are often unexpected (Barton, 2008; Pearson & Clair, 1998). How an organization responds to a crisis can dramatically affect its reputation, financial performance, and even survival (Coombs & Holladay, 2006). The preparation, response, and learning from a crisis fall under the realm of crisis management (Crandall, Parnell, & Spillan, 2010).

Inherent in crisis management is the attention that must be focused on anticipating and preparing for these unfortunate events. In general, proactive firms will prepare a crisis management plan and have a crisis management team (CMT) that meets on a regular basis. The charge of the CMT is to lead the organization in planning and implementing its crisis management plan as well as managing a crisis should one occur. After a crisis, the CMT should be instrumental in leading debriefing sessions and promoting the learning process that must take place after a crisis (Kovoo-Misra & Nathan, 2000; Lalonde, 2007). Indeed, if learning does not take place, a similar or worse crisis could occur to the organization in the future.

In this paper, we will focus on the preparation, or landscape survey stage of a crisis, or its crisis readiness (Crandall, Parnell, & Spillan, 2010). This is the stage where the organization looks at its internal and external environments and assesses its crisis vulnerability. The internal environment is the organization itself, while the external environment is the realm that exists outside of the organization. We propose that the condition of these environments can influence an organization's crisis readiness.

ORGANIZATIONAL CAPABILITIES, ENVIRONMENTAL UNCERTAINTY, AND GENERIC STRATEGIES

An internal look at the organization can focus on its abilities to carry out activities in a successful manner, also referenced to as organizational capabilities. This is often referred to as the S (strength) in a SWOT analysis. Likewise, the external environment can be assessed to some degree by looking at environmental uncertainties. This area is referred to as the T (threats) in a SWOT analysis. In strategic management theory, a company's generic strategy will emerge after a careful SWOT analysis.

Organizational Capabilities

Organizational capabilities reflect what an organization does well. In this study, we examine marketing, linking, technology, and management capabilities. Each of these is addressed below, followed by corresponding hypotheses.

Marketing capabilities. These capabilities address the ability of the firm to innovate by developing products and services that appeal to prospective customers. The firm then needs to market its products and services via effective promotion, pricing, and placement (i.e., distribution). Such an endeavor involves a thorough knowledge of the customer, a process that requires pre-planning and resources.

Pre-planning and resources are also part of effective crisis management. It is also important to understand what "might" go wrong with customers. Among retail chains, crises that could occur in this regard

include the delivery of a product that is of poor quality or even defective. Once in the hands of the customer, a crisis may commence. The result could be negative publicity or worse, a consumer boycott. Marketing management involves anticipating such events as well and doing what is necessary to alleviate the concerns of the customer and the general public.

Hypothesis 1a – Firms that display high levels of marketing capabilities will engage in more crisis readiness activity.

Linking capabilities. These capabilities address the ability of the firm to engage in meaningful working relationships with members of its supply chain. Managing the supply chain is a difficult task, even when activities are running well. Unfortunately, unforeseen crises can hinder the smooth operation of the supply chain and consequently, supply chain risk is a growing concern (Ganguly & Guin, 2007). For supply chain managers, a crisis is an event that can create a large-scale disruption to a company's supply resources. As a result, the company is then unable to meet the commitments it has made to its customers (Zsidisin, Ragatz, & Melanyk, 2005). Examples of crises that can disrupt the supply chain include major weather events, earthquakes, floods, transportation accidents, power outages, fires involving production and/or warehouse facilities, labor strikes, or wars.

Hypothesis 1b – Firms that display high levels of linking capabilities will engage in more crisis readiness activity.

Technology capabilities. Technological capabilities can also lead to the occurrence of crisis related accidents in the workplace. For example, Perrow (1999) maintained that certain types of technological configurations can lead to what he called a "normal accident." Such accidents can occur when there is a high level of interdependence between departments in a production facility. Perrow referred to this situation as tight coupling. Technologies that create both complexity and tight coupling can create a major crisis due to user errors. User errors of this sort are inevitable in certain industries such as in chemical or nuclear power plants (Choo, 2008).

Retail chains rely on information technology to communicate and manage their processes back and forth with their field units. A malfunction in such a system will create a crisis which can hinder information exchange and the smooth running of the company. As firms rely more on technology, their vulnerability to a technological crisis increases.

Hypothesis 1c – Firms that display high levels of technical capabilities will engage in more crisis readiness activity.

Management capabilities. Management capabilities illustrate the firm's readiness to address uncertainties in the market, as well as internal problems that can surface from time to time. In short, a firm that possesses strong management capabilities shows a proactive posture in the way it runs its business.

Retailers must have the capability of anticipating the market in terms of customer desires for new and innovative products and services. Likewise, the smooth operation of the organization depends on its ability to possess a strong human resource and information system. Crisis readiness also becomes part of this equation, as a sudden crisis event can launch a company into strong disfavor with its customers and the local community.

Hypothesis 1d – Firms that display high levels of management capabilities will engage in more crisis readiness activity.

Environmental Uncertainty

Environmental uncertainties represent external areas the firm must confront within its industry. In this study, we examine three areas of uncertainty: market, technological, and competitive uncertainties. Each of these is described next along with their corresponding hypotheses.

Market uncertainty. Satisfying the needs and desires of customers in the retail industry can be a daunting task. A mistake with a customer or market segment can cause a crisis for the firm. The crisis management literature is growing with examples of consumer related crises (Barton, 2008; Coombs, 2006; Crandall, Parnell, & Spillan, 2010; Hartley, 1993) ranging from simple dissatisfaction to wide-spread consumer boycotts.

Satisfying the customer also means conducting a smooth product recall when one is warranted. In China, retailers that carried Proctor & Gamble's SK-II line of cosmetics found themselves in a crisis during the summer of 2006. P&G reluctantly recalled its products after alleged impurities were found in this high-end cosmetic, which coincidentally was produced in Japan. To be eligible for a refund, consumers were required to return the product to the store of purchase with no less than one-third of the product remaining, complete and sign a form acknowledging that the product was of good quality, and wait several weeks for a refund to be processed (Guan, 2006).

The crisis took a dramatic turn on September 21, 2006 when hundreds of Shanghai women sought refunds at P&G's specified locations. Tempers flared when the women, who had been waiting in long lines, were told that their refunds would take three weeks to process. Later that same day, an angry group of consumers kicked down the front door of P&G's Shanghai office. In a frenzied response, some of the local retailers began offering immediate cash refunds to customers after P&G suspended its refund program (Crandall, Parnell, & Spillan, 2010). What should have been a smooth, systematic recall and refund procedure had quickly escalated into a crisis.

Hypothesis 2a – Firms that operate in environments with high market uncertainty will engage in more crisis readiness activity.

Technological uncertainty. The technological environment includes scientific improvements and innovations that can create both opportunities and threats for businesses. The speed of technological change varies considerably from one industry to another. As a result, technology affects a firm's operations as well as its manufacturing of products and services differently, depending on the industry in question.

Companies use advances in technology such as in computer systems, robotics, and other forms of manufacturing equipment to perform their operating tasks at lower costs and with less labor. However, technological forces not only create cost savings for firms, but can also be a source of crises. Such technological forces can shut down existing businesses and even entire industries by shifting demand from one product to another. Examples abound of such changes and include the movement from vacuum tubes to transistors, from steam locomotives to diesel and electric train engines, from fountain pens to ballpoint pens, from piston operating propeller airplanes to jets, and from typewriters to computers (Wright, Kroll, & Parnell, 1998).

Because technology can bring with it a host of uncertainties for the organization, it behooves management to engage in a higher level of crisis preparedness to avert potential crises that could occur due to technology.

Hypothesis 2b – Firms that operate in environments with high technical uncertainty will engage in more crisis readiness activity.

Competitive uncertainty. Retail stores operate in an industry with high degrees of competition. A mistake or crisis can cause a company to lose market share rapidly to a competitor. Over an extended period of time, a company may eventually give up enough revenue that it must exit the market altogether. The presence of Wal-Mart has caused the demise of many small companies because of the high level of competitive rivalry in this industry (Fishman, 2006).

Hypothesis 2c – Firms that operate in environments with high competitive uncertainty will engage in more crisis readiness activity.

Generic Strategies

Organizations employ strategies at the firm, business, and functional levels. At the business or competitive level, they craft strategies intended to translate their resources and capabilities into competitive advantage, and ultimately superior performance (Parnell, 2008). Business strategy typologies are frameworks that identify broad or generic competitive strategies utilized by businesses. Typologies have been developed to identify strategic types across industries (Zahra & Covin, 1993). A number of generic strategy typologies have been proposed (Parnell, O'Regan, & Ghobadian, 2006; Veett, Ghobadian, and Gallea, 2009).¹ Generic strategies developed by Porter (1980, 1985) and Miles & Snow (1978, 1986) have received much scholarly attention.

According to Porter's (1980, 1985) framework, a business can pursue superior performance by establishing either a cost leadership position (i.e., competing on the basis of lowering its operating costs across the organization) or by differentiating its products and services from those of its rivals. Further, either of these generic strategies may be pursued by focusing efforts on a given market niche as opposed to seeking to reach customers across an entire industry.

An interesting dilemma arises when a business attempts to combine a low cost and a differentiation simultaneously. Porter maintains that such a strategy is not conducive to high performance over the long term and results in an organization being "stuck in the middle" (Porter, 1980: 41). This notion has received both qualified support (Dess & Davis, 1984; Hambrick, 1982; Hawes & Crittendon, 1984) and challenges from a number of scholars (Buzzell & Wiersema, 1981; Hill, 1988; Murray, 1988; Parnell, 1997; Wright, 1987). Whereas Porter maintains that low cost and differentiation strategies are incompatible, those in the "combination strategy school" have argued that businesses that combine the two strategies may create synergies that can overcome any tradeoffs that may be associated with the combination. In this study, we will look at Porter's original three generic strategies and their association with crisis readiness. We do not consider these approaches to be mutually exclusive, however (Jusoh & Parnell, 2008).

Cost leadership generic strategy. A business pursuing a low-cost or cost leadership generic strategy seeks to produce and distribute its products or services at the lowest cost in the industry. In general, cost leadership is consistent with a de-emphasis on new products, unproven technologies, or other risk-laden operations (Porter, 1980). As such, organizations emphasizing a low-cost strategy may tend to allocate less time, energy, and resources in terms of crisis preparation.

¹ Typologies should not be confused with taxonomies. Both seek to categorize businesses in a given industry along strategic dimensions. Taxonomies are developed from empirical data, however, whereas typologies are conceptually based. Typologies are more concerned with delineating key strategic traits and assessing similarities and differences across strategic groups (see Venkatraman, 1989).

Hypothesis 3a – Firms that engage in a low-cost generic strategy will engage in less crisis readiness activity.

Differentiation generic strategy. A business pursuing a differentiation generic strategy seeks to distinguish its products or services from those of its competitors, thereby eliciting sales even if costs and prices are not relatively low. Differentiation tends to represent an ongoing challenge, as businesses seek to find new and create ways to develop offerings that are perceived as different from others in the marketplace (Porter, 1980). Hence, differentiation infers some degree of risk-taking, as new ideas and approaches are not always successful. Differentiated businesses are willing to tolerate a number of failures if they are countered by corresponding and profitable successes. As such, a greater emphasis on differentiation should also be accompanied by increased crisis readiness.

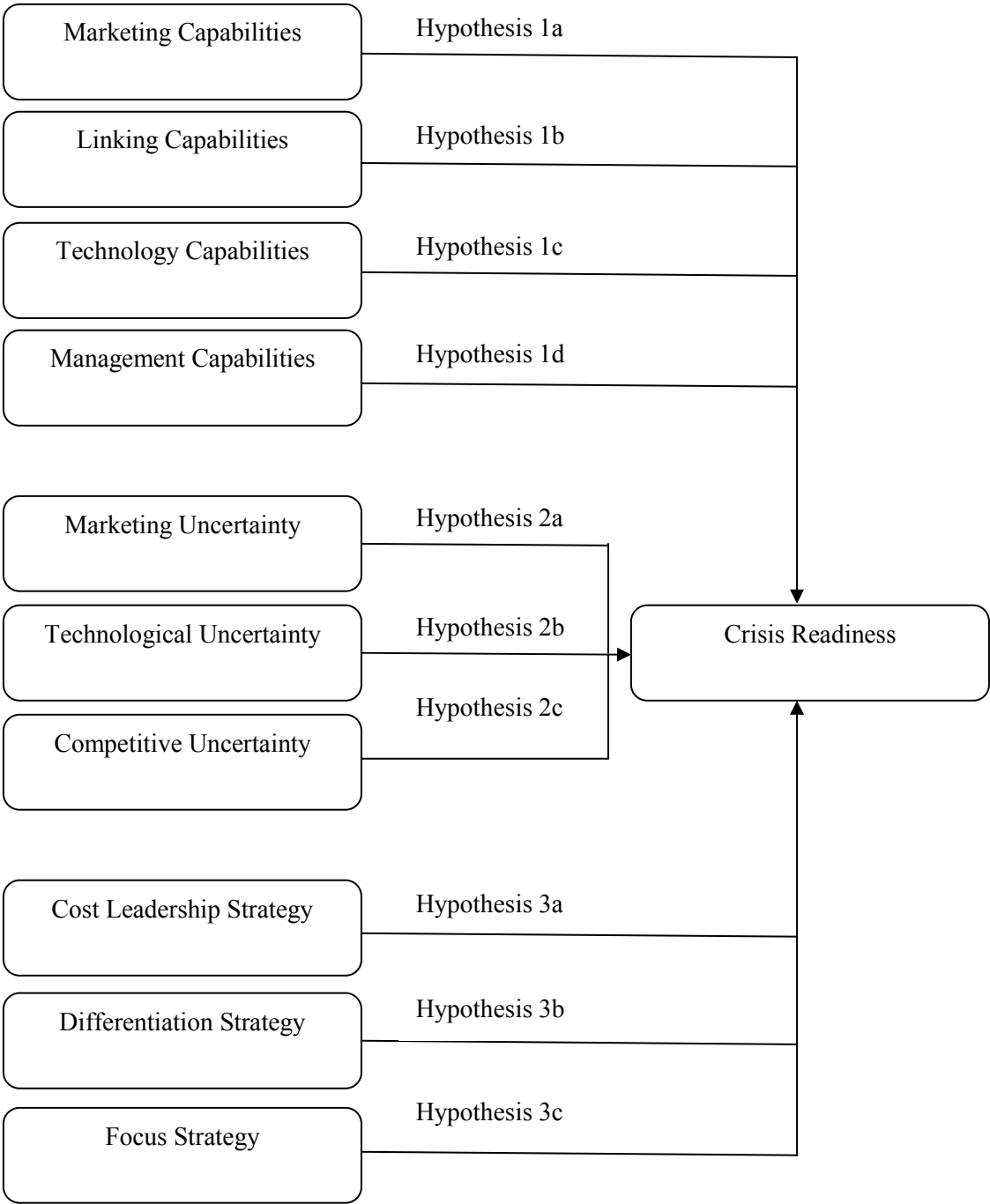
Hypothesis 3b – Firms that engage in a differentiation generic strategy will engage in more crisis readiness activity.

Focus generic strategy. A business pursuing a focus strategy—in conjunction with cost leadership, differentiation, or both—concentrates its efforts on satisfying the needs of a particular niche of the market instead of seeking to satisfy the broad requirements of a mass market. Such businesses are willing to forego opportunities that might exist across the market so that they can tailor their efforts to meet the more specific and exacting requirements of a particular subset (Porter, 1980). Hence, successful businesses adopting a focus approach must maintain high credibility among customers in the chosen niche. A crisis involving that particular niche can be devastating to the organization.

Hypothesis 3c – Firms that engage in a focus generic strategy will engage in more crisis readiness activity.

Figure 1 summarizes the proposed relationships between the independent variables aforementioned and the dependent variable, crisis readiness.

Figure 1
Proposed Relationships between the Study Variables and Crisis Readiness



METHODS

Sample

The survey instrument was administered to attendees at a retail trade show held in the United States in 2009. A total of 277 responses were received. All three management levels were represented in the sample. There were 35 non-managers (12.6%), 79 lower level managers (28.5%), 109 middle managers (39.4%), and 54 top managers (19.5%). There were more women (160; 57.8%) than men (117; 42.2%). The typical respondent had four years of management experience and five with the present organization. Businesses of various sizes were represented in the sample, as depicted in table 1.

Table 1
The Sample (n=277)

Variable	Range	Median	Mean	Std. Dev.
Management Experience (years)	0-22	3.72	3.64	
Organization Experience (years)	0-21	4.75	3.44	
Number of Employees	2-150,000	75	2,529	11,643
Annual Revenues (\$000)	94-6,470,600	12,193	225,377	720,422

Measures

Crisis readiness. This scale was developed and validated by Rousaki and Alcott (2007) and used to measure the dependent variable in the study. The eleven items in the instrument assess the internal functionality of the organization and serve as a proxy for crisis readiness. Sample items from the scale include “I have accessibility to crisis management resources”, “the members of the organization are trained to handle a crisis situation”, and “the organization’s culture will encourage its ability to manage a crisis”. Each item was arranged on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Because this was a relatively new scale in the crisis literature, we assessed the construct validity of the instrument by performing a confirmatory factor analysis. The results appear in Table 2. The eleven items loaded neatly into a single component with an Eigenvalue of 7.74 which explained 70.4 percent of the variance. All eleven questions were retained in the study. The variable was calculated by summing the responses to the questions ($\alpha = .96$).

Table 2
Factor Analysis for Crisis Readiness

Crisis Readiness Items	Factor Loading
I have high accessibility to crisis management resources.	.89
The organization has an adequate budget in its strategic plans in case of a crisis situation.	.88
The organization has an adequate crisis management plan.	.86
I am well informed about the resources and tools allocated for crisis response.	.84
The organization views crisis management as a corporate goal.	.80
The members of the organization are trained to handle a crisis situation.	.82
The organization will recover quickly after a crisis situation.	.87
The organization rewards employees for their part in detecting and reporting potential crisis signs.	.86
Key employees of the organization are well informed about the resources and tools allocated for crisis response.	.85
I am authorized to use the budget of the organization in order to cope with a crisis.	.69
The organization's culture will encourage its ability to manage a crisis.	.86
Eigenvalue	7.74
% Variance Explained	70.38

Extraction Method: Principal Component Analysis. Only one component could be extracted

Organizational capabilities. Scales utilized in the study were previously employed by DeSarbo, Benedetto, Song, & Sinha (2005) and measured four areas of organizational capabilities: marketing, market linking, technology, and management capabilities. The authors utilized the work of Conant, Mokwa, and Varadarajan (1990) for the marketing scale, and Day (1994) for the market linking and technology scales. DeSarbo and associates (2008) developed and validated their own scale to assess management capabilities. Sample items from the scale include “knowledge of customers” (marketing capabilities), “relationships with channel members” (linking capabilities), “ability of predicting technological changes in the industry” (technology capabilities), and “cost control capabilities” (management capabilities). The 24 items in the instrument were arranged on a 5-point Likert scale ranging from 1 (much worse) to 5 (much better).

Confirmatory factor analysis was conducted to determine construct validity. The results appear in Table 3. The six questions that assessed marketing capabilities loaded as a single component with an Eigenvalue of 6.44 that explained 26.8 percent of the variance. The six questions were retained in the study. Marketing capabilities was calculated as a variable by summing the responses to the six questions ($\alpha = .94$).

The validity of the other capabilities scales was also supported. The six questions that assessed technology capabilities loaded as a single component with an Eigenvalue of 4.01, explaining 16.7 percent of the variance. These six questions were retained in the study. Technology capabilities was calculated as a variable by summing the responses to the six questions ($\alpha = .93$). The six questions that assessed linking capabilities loaded as a single component with an Eigenvalue of 3.68, explaining 15.3 percent of the variance. These six questions were retained in the study. Linking capabilities was calculated as a variable by summing the responses to the six questions ($\alpha = .89$). The six questions that assessed management capabilities loaded as a single component with an Eigenvalue of 2.95, explaining 12.3 percent of the variance. These six questions were retained in the study. Management capabilities was calculated as a variable by summing the responses to the six questions ($\alpha = .89$).

Table 3
Factor Analysis for Organizational Capabilities

Scale Item	Component 1	Component 2	Component 3	Component 4
Market Capabilities				
Knowledge of customers	.87	.05	.08	.09
Knowledge of competitors	.89	.02	.13	.09
Integration of marketing	.86	.04	.08	.06
Segment & target markets	.88	.10	.08	.05
Effectiveness of pricing	.88	.07	.10	.06
Effectiveness of advertising	.87	.06	.04	.05
Linking Capabilities				
Market sensing capabilities	.09	.11	.75	.12
Customer-linking capabilities	.12	.04	.83	.11
Relationships with suppliers	.01	-.02	.77	.08
Ability to retain customers	.08	.04	.78	.12
Channel-bonding capabilities	.11	.12	.79	.05
Channel member relationships	.07	.11	.85	.06
Technology Capabilities				
New product development	.02	.88	.08	.03
Manufacturing processes	.04	.83	.09	-.02
Technology development	.16	.85	.08	.02
Technology change predicting	-.02	.85	.07	.09
Production facilities	.12	.86	.00	.09
Quality control skills	.02	.87	.07	.03
Management Capabilities				
Integrated logistics systems	.07	.09	.12	.77
Cost control capabilities	.03	-.01	.10	.81
Financial management skills	.01	.07	.17	.84
Human resource management	-.03	.04	.04	.82
Accurate revenue forecasting	.08	.00	.10	.81
Marketing planning processes	.25	.04	.03	.70
Eigenvalue	6.44	4.01	3.68	2.95
% Variance Explained	26.84	16.70	15.33	12.29
Cumulative % Variance	26.84	43.54	58.87	71.16

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 5 iterations.

Environmental uncertainty. The scale utilized in the present study was developed and validated by DeSarbo and associates (2005) and measured three areas of environmental uncertainty: Market environment uncertainty, competitive environment uncertainty, and technological environment uncertainty. Sample items from the scale include “Our customers tend to look for new products all the time” (market uncertainty), “the technological changes in our industry are frequent”, (technology uncertainty), and “one hears of a new competitive move almost every day” (competitive uncertainty). The 18 items in the instrument were arranged on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Confirmatory factor analysis was conducted to determine construct validity. The results appear in Table 4. The six questions that assessed technological uncertainty loaded as a single component with an Eigenvalue of 5.38 which explained 29.9 percent of the variance. The six questions were retained in the study. Technological uncertainty was calculated by summing the responses to these six questions ($\alpha = .94$). The six questions that assessed competitive uncertainty loaded as a single component with an Eigenvalue of 3.13 which explained 17.4 percent of the variance. The six questions were retained in the study. Competitive uncertainty was calculated by summing the responses to these six questions ($\alpha = .81$).

Market uncertainty was comprised of six questions. Five of the six questions loaded onto a single component with an Eigenvalue of 2.24 which explained 12.4 percent of the variance. The other question loaded on a fourth component which did not share any common elements with the other three components. This question was dropped from the study while the remaining five questions were summed to comprise the market uncertainty scale ($\alpha = .79$).

Table 4
Factor Analysis for Environmental Uncertainty

Scale Item	Component 1	Component 2	Component 3	Component 4
Market Uncertainty				
Customer product preferences	.11	.16	.79	-.03
Customers want new products	.09	.09	.82	.15
Price sensitivity of customers	.05	.02	.69	.35
Needs of new customers	-.01	-.02	.74	-.18
Cater to same customers	.16	.08	.27	.82
Market change predictions	.03	.24	.54	.16
Technological Uncertainty				
Fast changing technology	.88	.09	.04	.08
Technology opportunities	.89	.06	.03	.13
Technology forecasting	.87	.09	.09	-.02
New products	.87	.09	.12	.02
Technology is minor	.82	.12	.07	-.06
Technology changes frequently	.88	.07	-.02	.06
Competitive Uncertainty				
Competition is cutthroat	.08	.76	.03	.08
Promotion wars exist	.14	.65	.16	-.32
Competitor matching exists	.13	.73	.01	.08
Price competition exists	-.02	.81	.11	.03
Competitors move often	.19	.59	.21	-.24
Competitors are weak	.01	.66	.09	.28
Eigenvalue	5.38	3.13	2.24	1.02
% Variance Explained	29.86	17.37	12.42	5.68
Cumulative % Variance	29.86	47.23	59.65	65.33

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 5 iterations.

Generic Strategies. The generic strategy scales were developed by Zahra and Covin (1993) to categorize businesses along cost leadership, differentiation, and focus dimensions. Following the suggestions and subsequent validation by Luo and Zhao (2004), several items were amended to the scale. Sample items from the scale include “emphasis on finding ways to reduce costs” (low cost strategy), “targeting a clearly identified segment” (focus strategy), and “emphasis on new product development” (differentiation strategy). The 16 items in the instrument were arranged on a 5-point Likert scale ranging from 1 (very low) to 5 (very high).

Confirmatory factor analysis was conducted to assess construct validity. The results appear in Table 5. The four questions that assessed the focus strategy loaded as a single component with an Eigenvalue of 2.03 which explained 12.7 percent of the variance. The four questions were retained in the study. The focus strategy variable was calculated by summing the responses to these four questions ($\alpha = .79$).

Table 5
Factor Analysis for Generic Strategies

Scale Item	Component 1	Component 2	Component 3	Component 4
Low Cost Strategy				
Securing materials/components	-.09	.06	-.11	.85
Ways to reduce costs	.16	.07	.08	.72
Operating efficiency	.74	.06	.05	.31
Capacity utilization	.75	.14	-.11	.31
Price competition	.31	.02	.28	.69
Focus Strategy				
Product uniqueness	.16	.61	.39	.09
Target and market segment	.10	.69	.07	-.01
High price segment	.10	.81	.11	.09
Offering specialty products	.11	.85	.15	.06
Differentiation				
Use new methods/technologies	.53	.48	.28	.01
New product development	.82	.14	.31	.03
New product introduction	.75	.11	.36	-.10
Number of new products	.54	.39	.52	-.17
Advertising intensity	.26	.14	.69	-.13
Sales force utilization	.04	.28	.76	.20
Brand identification	.13	.13	.81	.14
Eigenvalue	5.64	2.03	1.68	1.26
% Variance Explained	35.23	12.66	10.44	7.86
Cumulative % Variance	35.23	47.89	58.33	66.19

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 6 iterations.

The five questions that assessed the low cost strategy loaded on two separate components. Table 5 shows that two of the questions loaded on Component 1 while the other three questions loaded on component 4. To reconcile this difference, we decided to view both components as two sub-variables of the low cost strategy. Questions three and four dealt with operating efficiency and capacity utilization, a variable we labeled “operations” because of its emphasis on lowering costs during the production process. The operations variable was calculated by summing the responses to these two questions ($\alpha = .72$). The remaining three questions dealt with direct cost reductions, a variable we labeled “cost reduction” because of its emphasis on securing resources or selling the product at the optimum price possible. The cost reduction variable was calculated by summing the responses to the remaining three questions ($\alpha = .69$).

The seven questions that assessed the differentiation strategy also loaded on two separate components. Table 5 shows that four of the questions loaded on Component 1 while the other three questions loaded on component 3. To reconcile this difference, we decided to view both components as two sub-variables of the differentiation strategy. Questions one through four dealt with items related to developing products, a variable we labeled “product differentiation”. The product differentiation variable was calculated by

summing the responses to these four questions ($\alpha = .85$). The remaining three questions dealt with advertising intensity, sales force utilization, and brand identification, a variable we labeled “market differentiation.” The market differentiation variable was calculated by summing the responses to these remaining three questions ($\alpha = .75$).

RESULTS

Table 6 lists the means, standard deviations, scale reliabilities, and Pearson correlations for the study variables. The dependent variable, crisis readiness, appears as the first variable in the table. The remaining independent variables are listed underneath. Multicollinearity diagnostics were initiated as part of the regression analysis. The resulting variance inflation factors (VIFs) figures ranged from 1.04 to 2.88 while the tolerances levels ranged from .35 to .96. A general rule of thumb in detecting multicollinearity is that the VIF should not exceed 10 (Belsley, Kuh, & Welsch, 1980). However, a more conservative standard set forth by Fox (1991) dictates that a tolerance $< .20$ and a VIF > 4.0 is cause for concern. Using the more conservative standard, the study variables were not considered problematic with respect to multicollinearity.

Insert Table 6 about Here

Hypothesis Testing

To test the hypotheses, a regression analysis was conducted with crisis readiness as the dependent variable. Table 7 lists the results.

Insert Table 7 about Here

The four organizational capabilities variables were regressed first on the crisis readiness variable. Model 1 shows an F-statistic of 23.78 with an adjusted R^2 of .25. All four independent variables were significant at this point in the analysis. We controlled for the organizational capability variables by next adding the three environmental uncertainty variables. Model 2 shows a resulting F-statistic of 18.51 with an adjusted R^2 of .31. This second phase represents an increase in R^2 of .06. Of the three uncertainty variables, only technological uncertainty is significant at this stage of the analysis. The four organizational capability variables also remain significant in Model 2.

The two cost leadership variables were added to the existing model. The result was an F-statistic of 15.87 with an increase in R^2 of .02, raising the total adjusted R^2 to .33. However, only the cost reduction variable was significant at the .01 level. In addition, this variable shows a negative β , indicating agreement with hypothesis 3a. Meanwhile, the four organizational capability variables and the technological uncertainty variables remained significant predictors of crisis readiness.

Cost leadership was controlled for by adding the two differentiation variables to the analysis. Model 4 shows an F-statistic of 17.41 and an increase in adjusted R^2 of .06, resulting in a new total adjusted R^2 of .39. Both differentiation variables are significant, however, and only the linking capability variable and the cost reduction variable remain the model at this stage of the analysis.

Finally, the focus strategy variable was added to the already existing model. However, it does not add any additional predictive ability to the model as there is no change in adjusted R^2 . Model 5 shows an F-statistic of 15.96 with the focus strategy not being a significant predictor of crisis readiness. At this final stage of the analysis, linking capability, cost reduction, and the two differentiation strategy variables remain significant predictors.

The third set of hypotheses addressed the linkage between generic strategies and crisis readiness. Recall that two of these variables, cost leadership and differentiation, were each found to load on two separate components in the factor analysis. Consequently, cost leadership was further separated into two sub-variables, cost reduction and operations. The regression analysis provided support for the cost reduction variable—but not the operations variable—in predicting crisis readiness. This result provides partial support for hypothesis 3a.

The differentiation variable was further subdivided into two sub-variables, product and market differentiation. The regression analysis showed a significant linkage in the predictive power of these sub-variables, providing full support for hypothesis 3b. Finally, no support was found for the focus strategy variable (hypothesis 3c) as a predictor of crisis readiness.

Table 8 lists the ten original hypotheses and their degree of support as a result of this analysis. The first four hypotheses addressed organizational capabilities and their relationship to crisis readiness. Partial support was found for hypotheses 1a, 1c, and 1d while full support was found for 1b. The second set of hypotheses address environmental uncertainties. Hypothesis 2b (technological uncertainty) received partial support while the other two hypotheses were not supported.

Insert Table 8 about Here

DISCUSSION AND CONCLUSIONS

Theoretical implications, practical implications, and finally, strengths, limitations, and future directions are addressed in this section.

Theoretical Implications

This study identified a link between an organization's capabilities and its degree of crisis readiness; organizations with higher capabilities showed higher degrees of crisis readiness. This finding confirms that a set of competencies within an organization can have a carry-over effect into newer areas of organizational management, such as crisis management.

Surprisingly, the evidence linking environmental uncertainties with crisis readiness is weak. Only technological uncertainty showed any link with crisis readiness. The finding supports the importance of technology in the retail industry and the need to anticipate unexpected crisis events.

As expected, the generic strategy selection appeared to be linked with crisis readiness. The low cost strategy of cost reduction displayed a negative link with crisis readiness. This finding could be explained by the fact that activities perceived to be non-essential by management are considered cost producing and hence, not part of the generic strategy of the firm. The differentiation strategy, as predicted, had a strong positive linkage with crisis readiness. This finding supports the notion that firms that choose to selectively differentiate their products and services carry that strategy over into sub-areas of management. Firms that decide to pursue a crisis management mentality demonstrate to their rivals a willingness to differentiate their infrastructure practices as well.

The focus strategy on the other hand, showed no relationship to crisis readiness. The most likely explanation is that the focus strategy, by definition, is either a low cost or a differentiation strategy, only focused on a specific target market. These differences did not appear to be sensitive enough to show up in the empirical analysis.

Implications for Managers

The role of technological capabilities can have important linkages with crisis management. For example, after the severe hurricane season of 2005, a number of retail chains began re-evaluating the capabilities of their crisis communication systems. In response, some retailers now utilize sophisticated technological applications, including GPS (global positioning systems) and satellite telephones so they can stay in touch with their employees during a crisis (Amato-McCoy, 2007).

Organizations that pursue a low-cost strategy must not lose sight of the need to remain “crisis ready”. Our findings revealed that organizations following a low-cost strategy, specifically in the area of cost reduction, are not as engaged in crisis readiness. We do not believe this finding to be a good thing. Money spent on crisis management, with its associated areas of crisis team formation, crisis plan formation, crisis vulnerability assessment, and crisis learning, should be viewed as an investment in the company’s well-being, not an expense item to be whittled down to the smallest dollar amount possible.

Finally, crisis readiness should be fostered in any organization, regardless of the type of generic strategy being practiced. Unfortunately, a number of managers carry an “it can’t happen to us” mentality in regards to the occurrence of a crisis (Barton, 2008; Crandall, Parnell, & Spillan, 2010; Nathan, 2000; Pearson & Mitroff, 1993). This type of thinking may be embedded in the culture of the organization and is often difficult to change (Roux-Dufort, 2000). Some managers may assume that crisis events are sensational occurrences that are very rare. Furthermore, when they do occur, they are assumed to always transpire at another organization (Lockwood, 2005). Indeed, some crises do fall in the category of being sensational, such as Hurricane Katrina or the 9/11 terrorist attacks. In actuality though, most crises are far less dramatic, but still powerful in terms of disrupting the daily operations of the firm. Examples of these include product recalls, industrial accidents, fires, and floods.

Strengths, Limitations, and Future Directions

The main strength of this study is that we provide an empirical glimpse into factors that relate to an organization’s crisis readiness. Empirical studies and model building are a growing area in this relatively new discipline of crisis management. Traditionally, this field has focused more on case studies as a research tool. Future development of this field needs to supplement case studies with more rigorous empirical studies (Crandall, Parnell, & Spillan, 2010).

One limitation of the study was that only organizational capabilities (the S or strengths in the SWOT analysis) were included in the internal analysis of the organization. Following strategic management protocol, the limitations or weaknesses (the W of the SWOT analysis) of the organization should also be evaluated in future studies. Hence, a determination of weaknesses could also indicate linkages with the organization’s crisis readiness. For example, do organizations, upon knowing their weak areas, enhance their crisis readiness in those areas? An organization with an aggressive labor union would need to make special preparations in the face of an impending strike, should contract negotiations not go well (Crandall & Menefee, 1996).

Likewise, this study only focused on the T (threats) of the SWOT analysis. Looking at the opportunities (the O in the SWOT analysis) could also provide useful linkages with crisis readiness. For example, do firms that aggressively pursue new opportunities, particularly in a global sense, build up their crisis readiness, as crisis management theory would recommend.

The present study focused on a single (broad) industry, retailers. As such, the influence of cross-industry factors were minimized. Nonetheless, the generalizability of findings to other industry remains untested. Future studies that consider other industries, most notably manufacturing concerns, would be worthwhile.

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Table 6
Means, Standard Deviations, Reliabilities², and Pearson Correlations among Study Variables

Study Variables	Means	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Crisis Readiness	34.94	11.27	(.96) 11												
2. Marketing Capabilities	20.71	6.69	.36** 6	(.94) 6											
3. Linking Capabilities	19.80	5.07	.36** 6	.20** 6	(.89) 6										
4. Technology Capabilities	16.98	6.09	.25** 6	.14* 6	.17** 6	(.93) 6									
5. Management Capabilities	18.63	5.44	.26** 6	.17** 6	.24** 6	ns 6	(.89) 6								
6. Market Uncertainty	14.34	4.30	.12* 5	ns 5	ns 5	ns 5	ns 5	(.79) 5							
7. Technological Uncertainty	17.43	7.07	.38** 6	.34** 6	ns 6	ns 6	.14* 6	.15* 6	(.94) 6						
8. Competitive Uncertainty	18.97	5.56	.15** 3	ns 3	.16** 3	ns 3	ns 3	.27** 3	.22** 3	(.81) 3					
9. Cost Leadership (cost reduction)	8.57	2.69	ns 2	ns 2	.17** 2	ns 2	.22** 2	.17** 2	ns 2	.19** 2	(.69) 2				
10. Cost Leadership (operations)	6.05	1.88	.30** 4	.27** 4	.24** 4	.17** 4	.29** 4	.13* 4	.35** 4	ns 4	.41** 4	(.72) 4			
11. Differentiation (product)	12.20	3.66	.51** 4	.43** 4	.20** 4	.33** 4	.26** 4	ns 4	.56** 4	.17** 4	.17** 4	.58** 4	(.85) 4		
12. Differentiation (market)	9.62	2.81	.48** 3	.31** 3	.28** 3	.18** 3	.28** 3	.24** 3	.47** 3	.40** 3	.21** 3	.25** 3	.56** 3	(.75) 3	
13. Focus Strategy	13.61	3.55	.34** 4	.25** 4	.22** 4	ns 4	.12* 4	.19** 4	.32** 4	.15* 4	.18** 4	.26** 4	.50** 4	.46** 4	(.79) 4

n = 277

*p < .05

** p < .01

ns = not significant

² Alphas appear on the diagonal for each scale in parenthesis. Number of items in the scale appears below the alpha.

Table 7
Results for Hierarchical Regression
Dependent Variable – Crisis Readiness

Independent Variables	Step 1		Step 2		Step 3		Step 4		Step 5	
	β	Sig.	β	Sig.	β	Sig.	β	Sig.	β	Sig.
Organizational Capabilities										
Marketing Capabilities	.261	.000	.176	.001	.142	.010	.077	.152	.076	.159
Linking Capabilities	.252	.000	.254	.000	.260	.000	.229	.000	.225	.000
Technology Capabilities	.155	.004	.141	.006	.125	.015	.067	.184	.069	.174
Management Capabilities	.140	.010	.112	.033	.122	.023	.077	.134	.080	.122
Environmental Uncertainties										
Market Uncertainty			.064	.221	.074	.157	.054	.285	.049	.332
Technological Uncertainty			.258	.000	.233	.000	.085	.154	.085	.155
Competitive Uncertainty			-.005	.924	.022	.687	-.037	.482	-.035	.510
Generic Strategies										
Cost Reduction (Cost Leadership)					-.170	.003	-.189	.001	-.192	.001
Operations (Cost Leadership)					.119	.052	.059	.364	.063	.341
Product Differentiation							.206	.007	.191	.017
Market Differentiation							.234	.000	.227	.001
Focus Strategy									.036	.529
F – statistic	23.78	.000	18.51	.000	15.87	.000	17.41	.000	15.96	.000
Adjusted R² (ΔR^2)	.25		.31	(.06)	.33	(.02)	.39	(.06)	.39	(.00)

n = 277

Partial support of hypotheses
Full support of hypotheses

Table 8
Summary of Hypothesis Testing

Hypothesis	Proposed Relationship	Degree of Support
1a	<i>Firms that display high levels of marketing capabilities will engage in more crisis readiness activities.</i>	Partial
1b	<i>Firms that display high levels of linking capabilities will engage in more crisis readiness activities.</i>	Full
1c	<i>Firms that display high levels of technical capabilities will engage in more crisis readiness activities.</i>	Partial
1d	<i>Firms that display high levels of management capabilities will engage in more crisis readiness activities.</i>	Partial
2a	<i>Firms that operate in environments with high market uncertainty will engage in more crisis readiness activities.</i>	None
2b	<i>Firms that operate in environments with high technical uncertainty will engage in more crisis readiness activities.</i>	Partial
2c	<i>Firms that operate in environments with high competitive uncertainty will engage in more crisis readiness activities.</i>	None
3a	<i>Firms that engage in a low-cost generic strategy will engage in less crisis readiness activities.</i>	Partial
3b	<i>Firms that engage in a differentiation generic strategy will engage in more crisis readiness activities.</i>	Full
3c	<i>Firms that engage in a focus generic strategy will engage in more crisis readiness activities.</i>	None

CORPORATE SOCIAL RESPONSIBILITY AND CORPORATE BOARD COMPOSITION: A VIEW FROM CHINA

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ABSTRACT

While the majority of CSR research has focused on the link between CSR and CFP in a Western context, we know little about the antecedents of CSR. Theoretical work posits that CSR is driven by firm size, diversification, R&D, advertising, consumer income, government sales, labor market conditions, and industry life cycle (McWilliams & Siegel, 2001). Other researchers have argued that intraorganizational factors, competitive dynamics, institutional investors, end-consumers, governmental regulators, and NGOs lead to CSR (Haigh & Jones, 2006). While theoretical models exist, empirical evidence examining antecedents of CSR has been limited with the exception of a few studies. One of the few studies on antecedents of CSR found a significant relationship between CEOs' international experience and firm corporate social performance lending preliminary support to the role of a firm's leaders in CSR efforts (Slater & Dixon-Fowler, 2009).

In China, firm leaders understand the increased pressure for accountability. Boards of directors, in particular, may be paying more attention to CSR related firm performance as the emphasis on CSR in China grows. This phenomenon has been seen in US firms where over 25% of *Fortune* 500 firms now have specialized board committees responsible for overseeing environmental and other public policy related issues while over a decade ago less than 5% of firms had such committees (Lublin, 2009, Aug. 11, *WSJ*). A few studies have found evidence suggesting that directors play an important role in corporate social performance (Dixon-Fowler, 2010, unpublished dissertation, Kassinis & Vafeas, 2002) although the influence of boards on CSR has been largely neglected.

Traditionally, directors are thought to serve in three primary roles: control, resource dependence, and service (see Johnson, Daily, & Ellstrand, 1996 for review). As such, directors bring expertise and experience to the organization and may monitor top management performance, secure important resources, provide expert advice, and oversee strategy development and implementation. Agency theory, the dominant perspective in governance research, asserts that managers are self-interested. Thus, directors act as agents of shareholders and thus play a monitoring or control role in ensuring that managers act in the best interest of firm shareholders by enhancing firm performance (Berle & Means, 1932; Fama & Jensen, 1983; Jensen & Meckling, 1976). The majority of research in the governance literature focuses on the need for separation of ownership and control and thus the general argument that inside directors are less able to fulfill their monitoring responsibilities compared to outside directors (Lorsch & MacIver, 1989).

One of the few studies of Chinese boards found that small boards were associated with higher EPS and EVA but lower ROA and that the number of board meetings did not appear to matter (Changqing &

Jianqing, 2004). Interestingly, and in contrast to Western-based governance theories, a negative association was found between the proportion of independent directors and firm performance and this relationship appeared to be strengthened by the adoption of regulation in 2001 by the Securities Regulatory Commission requiring listed companies to introduce independent directors (Changqing & Jianqing, 2004). This reform, in fact, was primarily influenced by the Western based governance model relying on assumptions regarding human behavior which may not be appropriate or well suited for the Chinese context (Tian & Lau, 2001). Indeed, when tested on a sample of Chinese companies, evidence of a stewardship role received stronger empirical support than the agency hypothesis (Tian & Lau, 2001). From this perspective, directors may be concerned with their firm's strategy and act in the best interest of shareholders because they view the firm's performance as a reflection of their own abilities and reputation (Fama, 1980; Johnson et al., 1996). Thus, by acting as a steward of the firm, directors essentially manage their own reputations (Johnson et al., 1996; Fama, 1980; Lane, Cannella, & Lubatkin, 1998). Another study found evidence for a stronger resource dependence role of Chinese boards and again the control role was less pronounced (Young, Ashlstrom, Bruton, & Chan, 2001). Overall, it appears that Chinese directors may be motivated to pursue CSR initiatives if they perceive that their own reputation is linked to that of their firm.

Private business enterprises in China also differ in important ways from Western counterparts (Weidenbaum, 1996). For example, there is often cross-ownership across multiple firms instead of a large unitary firm and succession patterns differ as well (Weidenbaum, 1996). Further, the characteristics of Chinese family enterprises may give them greater flexibility during periods of organizational challenges and change (Weidenbaum, 1996).

Board roles and characteristics vary not only across countries but also by company types within the same countries (Corbetta & Salvato, 2004). In China, private-owned enterprises are family owned and operated with large proportions of top management and board directors being made up of family members. The body of literature on family firms has largely failed to recognize potential differences (Corbetta & Salvato, 2004). Family firms board characteristics may reflect firm power, experience, and cultural makeup and governance theories and prescriptions should be adapted appropriately (Corbetta & Salvato, 2004). For example, the directors of private-owned firms may face fewer constraints enabling them to have a more direct influence on firm processes and outcomes (Dailey & Dalton, 1993). Family members serving on the board may have a more intimate understanding of firm goals, practices and procedures. Moreover, the social capital existing between family members along with a more centralized and concentrated leadership and decision-making structure on the board may result in greater effectiveness. Given that family members may share similar social networks, however, the resource dependence role of any individual director may be reduced.

In sum, in order to shed important insight on CSR in China, our exploratory aims to provide insight on two questions. First, what is the relationship between CSR and CFP in private-owned enterprises in China? Second, what is the role of the board of directors on the CSR of these companies? Whereas data on public firms in the U.S. and abroad is fairly accessible, data on private enterprises, particularly in China is rare. Our analysis will be applied to a dataset compiled through a combination of mail surveys, telephone interviews, and face-to-face interviews and obtained usable responses from 878 of 1150 companies for a response rate of 76.3%. While this study is exploratory in nature, future longitudinal studies would further enhance our understanding of CSR in Chinese firms. Traditionally, Chinese firms also tend to have much greater family member representation on boards of directors. However, perhaps as a result of seeking greater legitimacy in a global market there does appear to be an emerging trend toward less family control (Yeung, Wai-Chung, & Soh, 2000). A close examination of this trend may provide particularly interesting insights.

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CHARACTERISTICS OF STRATEGIC PLANNING IN SMALL MANUFACTURING FIRMS

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ABSTRACT

Numerous articles in academic publications and practitioner-oriented journals have focused on the activities, planning processes, and effectiveness of large firms. However, in recent years a growing amount of research has recognized the importance of planning for small businesses. This special attention has been reinforced by studies showing that these firms have particular attributes that provide them certain competitive advantages. However, there is surprisingly very little empirical work examining the techniques, tools, and approaches to planning that are actually being used by small companies.

This study is designed to partially fill this gap in the literature by reporting the results of a survey of 838 small firms. It seeks to explore their strategic planning tools and techniques. The intent is to develop a profile for small firms with respect to their strategic planning processes. Some explanations as well as implications, limited generalizations and areas for future study are developed.

INTRODUCTION

Research interest in planning began in earnest in the late 1960s. While a large body of this literature has concentrated on large firms, in recent years a growing amount of research attention has been devoted to small companies. There have been four streams of research and writing about these businesses. In one line of research, some have examined the differences between formalized and non-formalized plans and report that the planning process should be far more informal in small firms than it is in large companies (Thomas, 1989; Shrader, Mulford, & Blackburn, 1989). Others have developed various schemes for classifying small businesses based on the thoroughness or sophistication of the planning process (Rhyne, 1987; Bracker & Pearson, 1986; Hahn & Powers, 1999). For example, Rue and Ibrahim (1998) operationalized the construct "planning sophistication" by using the five steps to the strategic planning process: defining a firm's mission; performing an environmental scan and analysis; establishing objectives, strategies, and tactics; implementing; and conducting a performance review and making the necessary adjustments.

In a separate line of research, some attention has been given to whether small firms focus on operational, as opposed to strategic, planning. A number of researchers have shown that small businesses tend to place great emphasis on operational planning (Shrader, *et al.*, 1989). This is supported by Carson and Cronie (1990) who found that planning, when conducted by small companies, is limited in its scope and activities and therefore tends to be operational. Indeed, some writers have argued that small companies should not attempt to use planning techniques found in larger businesses and that the usage of these techniques could be one of the reasons behind the failure of many small businesses (Scarborough & Zimmerer, 1987). Other studies strongly suggest that simply engaging in a long-term planning process is beneficial to small firms as it leads to an improved understanding of the business (Lyles, *et al.*, 1993). The adoption of a long-term perspective has intuitive appeal. Many small companies are less constrained by the need of professional managers to focus on short-term performance targets, and therefore are apt to adopt a more rational approach to long-term planning. Whereas these managers are inclined to maximize personal benefits over their expected period of employment, time-horizons of small firms' owners tend to

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extend over a lifetime or across generations.

The third area of research addresses the link between planning and performance. Empirical results are currently inconclusive. Some have found no differences between formalized and non-formalized plans in terms of their impact on performance; both types lead to improved performance (Ackelsberg & Arlow, 1985). Others contend that good planning is a key to a firm's success and is a major contributor to profitability. Bracker and Pearson (1986) identified different levels of performance associated with different levels of planning. Schuman, Sussman, and Shaw (1985) found that only 49.9 percent of small firms prepared a formal business plan. Of those that did, 92 percent reported that their company had benefited from it. A survey of small firms revealed that 94 percent of those that performed strategic planning reported improved performance (Baker, *et al.*, 1993). Another study compared small firms with structured planning processes with those whose planning is unstructured and found that the former had plans that are more thorough and accurate, and their performance is significantly higher (Lyles, *et al.*, 1993). A meta-analysis by Schwenk and Shrader (1993) of fourteen studies found a strong relationship between long-range planning and small company performance. A more recent study (Rue & Ibrahim, 1998) suggests that these inconsistencies may be an indication that performance depends more on the content of the plan than on the formality of the planning process.

Finally, in what may be an emerging research stream, limited attention has been given to the planning tools and techniques of small businesses. In their seminal study of the planning practices of these firms, Rue and Ibrahim (1996) studied these tools and techniques. They surveyed small firms to determine whether they develop written plans; the duration of these plans; the external factors they consider when plans are developed; the objectives they set; the pro forma financial statements they develop; whether computers or consultants are used in the process; and how frequently company performance is evaluated.

PURPOSES OF THE STUDY

Despite these research efforts and the growing importance of small companies in the U.S. economy in general, there is surprisingly little empirical work that has examined the techniques, tools, and approaches to planning that are actually being used by these businesses. Although the Rue and Ibrahim (1996) study provided interesting insights, it focused on family-owned businesses - typically a subset of small firms.

The present study is designed to partially fill this gap in the literature by reporting the results of a survey of small businesses in the United States. It continues in the tradition of the research stream that attempts to uncover meaningful distinctions among firms, which often are unseen when companies are combined into one large group.

Specifically, it seeks to examine the following areas: (1) whether small firms develop any written plans, (2) the external factors that serve as inputs to the plans, (3) the types of objectives that are formulated, (4) how those who follow a growth strategy intend to achieve it, (5) the types of financial planning undertaken by these companies, (6) whether outside consultants or (7) computers are used to assist in the planning process, and (8) how frequently overall performance is reviewed to detect differences between planned and actual performance. The intent is to develop a profile for small businesses with respect to their strategic planning processes.

METHODOLOGY

Sample

The sampling frame consisted of firms listed in the *North Carolina Manufacturers' Directory*, the *Georgia Manufacturing Directory*, and the *South Carolina Industrial Directory*. Only non-affiliated, autonomous companies were included in the sampling procedure. Consistent with previous writing on the

subject, the sample was restricted to a particular region since firms within the same region execute their activities under similar influence from environmental conditions and complexity (Wolff & Pett, 2000).

Also, the analysis focused on one industry, manufacturing, thus ensuring greater homogeneity among the companies. This addresses a concern expressed by Westhead and Cowling (1998) who argued that most small business research is characterized by a failure to control for differences based on the main industrial activity for the companies under study.

In the three states represented in the sample, manufacturing's share of the gross state product in 2008 was \$43.3 billion (10.9%) in Georgia, \$78 billion (19.5%) in North Carolina, and \$25.2 billion (16.1%) in South Carolina. In Georgia, 408,300 persons were employed in manufacturing. On average, their wages in 2008 were 10% higher than overall wages. Comparable figures for North and South Carolina were 514,400 (24%) and 242,400 (33%), respectively (National Association of Manufacturers, 2008). Small businesses account for approximately 66 percent of total employment in the three states (The Small Business Economy, 2009).

Data was collected from a total of 2100 small firms via a mail questionnaire of the owners or top executives. Prior to mailing the questionnaire, telephone calls were made to ascertain that these companies were still in business, confirm the name and title of the key top executive, notify them that they will be receiving a questionnaire within a few days and apprise them of the purpose and importance of the survey. Although there is no universally accepted criterion for delineating small firms, the number of employees was selected as the key indicator of firm size (Wolff & Pett, 2000). In this study the definition of "small firm" follows the U.S. Small Business Administration classification. That is, firms that employ fewer than 500 employees were selected.

Each respondent was sent a copy of the research instrument accompanied with a letter explaining the project and assuring them of the confidentiality of their answers. A first mailing and one telephone follow-up urging participants to complete and return the questionnaire generated 838 completed and usable responses. Since 72 responses were unusable, this resulted in a net overall response rate of 40 percent.

Measures

Respondents were asked to indicate their present position with the company (e.g., CEO, President), in what year the company was founded, the number of full-time employees, the type of ownership of the business, and who founded the company. In addition, they were requested to indicate whether their firm prepares a written plan and, if so, the time period it covers.

Following the convention used in previous research (Rue & Ibrahim 1996), those with written plans were asked whether they attempt to identify and analyze any of the following external factors: population/demographic trends, national political developments and trends, international political developments and trends, personal family incomes, social/cultural trends, non-product technological breakthroughs, labor-management relations, and national and international economic developments and trends. They were then asked if their plan includes quantified objectives for any of the following: sales, earnings, return on investment, capital growth, market share, sales/earnings ratio, and international expansion. Those with a growth strategy were asked whether they develop plans and budgets for any of the following: hiring and training of key management personnel, plant expansion, new product development, managerial succession, corporate acquisition, equipment acquisition, research and development, advertising, and expansion of international markets. Additional items requested information on the types of pro forma statements which are developed; whether outside consultants assist in formulating these plans; whether computers are employed in the planning process; and how frequently

performance is evaluated and whether, as a result, the plans are reviewed and revised.

RESULTS

The title of President was held by 592 of the respondents, 468 were CEO's, and 456 chaired their respective boards of directors. Eighty-one percent were private companies and 89 percent were founded by the respondents or their parent(s). The median number of employees was 33, and the median age of the firms was 29 years.

Written Plans

The great majority of the firms in the sample (85.9%) do prepare some type of written plan. Table 1 presents the time period they cover. Almost 50 percent prepare plans extending three or more years into the future. Thus much of the planning that is being undertaken appears to be long-range as opposed to operational. With four exceptions, all those with plans extending longer than five years specified they had an exit strategy in mind. Brief comments indicated that this strategy was chosen due to lack of capital, the owner's age or health concerns, or children who were not interested in the business.

Table 1: Time Period Covered in Long-Range Plans ^a

Time Period	Total
	(n = 838)
One year	110 (13.1)
Two years	125 (14.9)
Three years	174 (20.8)
Four years	128 (15.3)
Five years	144 (17.2)
Over 5 years	39 (4.7)
No written plans	118 (14.1)

^a Column percentages are in parentheses.

Planning Techniques

Consistent with the Rue and Ibrahim (1996) study, this survey specifically sought information concerning how the respondents approached the following general areas.

Premises

Because of the potential impact of external forces on a company's future, it is essential that the plan address some of these factors. Premising refers to the consideration of forces outside of the immediate operating environment of the firm. Generally, they are beyond its control. Environmental scanning is the means by which managers can perceive and cope with external events and trends (Miller & Toulouse, 1998). More than two decades ago, it was noted that environmental scanning had become a widely accepted part of the strategic planning process of many U.S. companies (Jain, 1984) and that the effectiveness of strategic planning is strongly influenced by the ability to do so (Specht, 1987). Researchers report that such activities contribute significantly to firm performance (Preble *et al.*, 1988; Venkatraman & Prescott 1990).

As shown in Table 2, 12.4 percent of small businesses do not attempt to identify any premises. The most frequently used relate to national economic (62.5%) and political developments and trends (42.8%),

followed closely by international economic trends (40.8%). This is probably due to the availability and accessibility of related information and the ability to easily envision a relationship between these events and their businesses.

Table 2: Premises Contained in Written Plans ^a

Premise	Total (n = 720)
Population/demographic trends	147 (20.4)
National political developments	308 (42.8)
International political developments	181 (25.1)
Personal family incomes	132 (18.3)
Social/cultural trends	137 (19.0)
Non-product technological breakthroughs	70 (9.7)
Labor-management relations	147 (20.4)
National economic trends	450 (62.5)
International economic trends	294 (40.8)
No premises identified	89 (12.4)

^a Column percentages are in parentheses.

Objectives

Planning can only be a useful managerial function if objectives are properly chosen. Without concrete objectives, the entire planning activity can easily turn into a futile exercise. Objectives provide benchmarks for evaluating progress and represent a managerial commitment to achieving certain results. Companies whose managers set objectives typically outperform those that do not (Thompson & Strickland, 2003). Many firms today are striving to attain multiple objectives as opposed to a single one. When choosing multiple objectives, the strategist must be careful to ensure that the different objectives are compatible. Managers must set objectives so that they are specific and practical; they should challenge the company but must be attainable. Whenever possible, quantified objectives are desirable.

Table 3: Objectives Stipulated in Written Plans ^a

Objective	Total (n = 720)
Sales	625 (86.8)
Earnings	176 (24.4)
Return on investment	160 (22.2)
Capital growth	228 (31.7)
Market share	215 (29.9)
Sales/earnings ratio	88 (12.2)
International expansion	369 (51.3)
No objectives are established	91 (12.6)

^a Column percentages are in parentheses.

The great majority of those with written plans establish quantified objectives. Only 12.6% indicated that

no objectives are established. Table 3 shows that sales are assigned the highest priority by both groups, probably because they are foremost in the minds of the managers. Indeed, this measure was specified by every company that prepares quantified objectives. Among those who reported setting objectives, all but 79 had more than one measure.

Growth

Eight-six percent of respondents indicated that they pursue a growth strategy. In today's world, many executives view growth as the best path to survival and higher earnings. This is a very seductive strategy; it is exciting and ego-enhancing and is viewed as an indication of success. This strategy is especially important to the survival of small firms. They must formulate and implement growth strategies to avoid decline and enhance their ability to remain competitive (Poza; 1989). On the other hand, growth, if rapid, can be difficult to sustain. Management may possess strong start-up skills but may not have the expertise required to manage subsequent growth (Willard *et al.*, 1992), and the firm's systems and processes may not be adequate (Forbrum & Wally, 1989).

Table 4: Approaches for Implementing Growth Strategies ^a

Area	Total (n = 615)
Hiring and training of key management personnel	195 (31.7)
Plant expansion	216 (35.1)
New product development	13 (2.1)
Managerial succession	56 (9.1)
Corporate acquisitions	75 (12.2)
Equipment acquisitions	304 (49.4)
Research and development	134 (21.8)
Advertising	315 (51.2)
Expanding international markets	362 (58.9)
No plans	149 (24.2)

^a Column percentages are in parentheses.

As shown in Table 4, approximately one-half of the companies prepare plans and budgets for advertising and equipment acquisitions. Of all the factors listed in this section, these areas are probably the easiest to predict. It is interesting that corporate acquisitions are considered by only 12.2 percent of respondents. Although they are difficult to forecast, it has been shown that those who grow through acquisitions generally outperform those that do so through internal means (Sharma, 1998). Finally, succession plans are developed by less than ten percent of these companies. Among those who reported that their strategy is one of growth, 24.2 percent failed to develop any specific plans and budgets to carry out this strategy.

Financial Analyses

One of the dangers associated with growth stems from the financial mechanisms which are involved in the growth process. The problems caused by the interaction of cash flow and growth have perplexed managers for years. Managers realize that they must maintain a reserve of cash (or other readily convertible current assets) which is adequate to meet expenses as they fall due. Their dilemma is a balancing process that requires accurate forecasts. Once the forecasts for future expenditures (and perhaps growth) are predicted, they must be evaluated to determine if they are financially sound. At the same

time, enterprising managers desire to utilize the company's financial resources to provide for growth and the generation of greater profits. They understand that leverage (debt) can be used to balance the risk between the owners and creditors and is a valuable tool when a project yields a higher rate of return than the cost of capital.

Although the financial aspects of business planning can be quite complex, they should culminate in the preparation of pro forma statements. Respondents were asked if they prepared pro forma balance sheets, income statements, and cash flows as an integral part of their plan. Eight companies did not respond to this question. Table 5 shows that a large majority prepare pro forma financial statements. The concern for profit is reflected in the fact that more firms prepare a pro forma income statement (75.1%) than a balance sheet (51.7%) or cash flow analysis (58.7%).

Table 5: Pro Forma Financial Statements Used in Planning ^a

	Total
Financial Statement	(n = 712)
Balance Sheet	368 (51.7)
Cash Flow Analysis	418 (58.7)
Income Statement	535 (75.1)
None	157 (22.1)

^a Column percentages are in parentheses.

Outside Consultants

This study sought information as to whether consultants are used to assist in the planning process. Seven firms did not respond to this question. Table 6 shows that a large percentage (46.4%) do not use the services of consultants in their planning process. This is not surprising since the great majority of smaller businesses are probably reluctant to use outside resources. The data clearly indicate that consulting firms (mostly auditing firms, tax consultants, and international trade specialists) are the single largest source of consultants. They are followed by free lance individuals - primarily business planners - and, finally, contract research firms.

Table 6: The Use of Outside Consultants in Long-Range Planning ^a

	Total
Source of Consultants	(n = 711)
Consulting Firms	277 (39.0)
Contract Research Firms	11 (1.5)
Free Lance Individuals	115 (16.2)
None	330 (46.4)

^a Column percentages are in parentheses.

The Use of Mathematical Models and Computers

The increasing proliferation of computers should make more and better information available for planners. Mathematical models can be developed to test alternative courses of action. Many parts of the planning process can be automated, thus allowing the planners more time to develop strategies. Many articles have been written proclaiming the virtues of computers and mathematical models and how they can assist the planner, particularly by reducing uncertainty and supporting decision making (e.g.,

Georgeoff & Murdick, 1986; Van den Poel & Buckinx, 2005). Although the focus of these studies has been on large firms (Klein & Linneman, 1984), more recent writers have discussed how small businesses can successfully use these tools to assist in planning (e.g., Ahire, 2001). Many techniques are now suitable for small firms because of advances in information technology and the increasing power and declining cost of computers. Fully recognizing the usefulness of these tools, this study sought to determine whether computers or mathematical models are used on a regular basis to assist in developing their written plans. The questionnaire did not inquire as to whether computers are used in areas unrelated to planning.

Among those with written plans, who use, on a regular basis, a computer or mathematical model to assist in planning was 37%. Brief comments describing their use were solicited. The most widely used applications are related to financial and sales forecasting as well as financial control. They assist in making decisions concerning sales, financing, inventory, production, and advertising. The specific techniques include spreadsheets, trend analysis, pro forma models and, in three percent of cases, return on investment simulations.

Evaluation

Because planning is a continuous process, plans should be periodically reviewed and revised. In their review of research in family businesses, Chua, Chrisman and Sharma (1999) concluded that very little is known about how company performance is evaluated in many small firms. Clearly, those charged with responsibility for the plan must determine whether the company's performance and other activities are compatible with the plan. All too often a sophisticated written plan is developed and never implemented. Because of the uncertainty involved with planning, the plan must be updated as information is gathered and changes take place.

Table 7: Frequency of Review and Revision of Long-Range Plans ^a

	Total
	(n = 709)
Weekly or less	38 (5.4)
Monthly	164 (23.1)
Quarterly	211 (29.8)
Semi-Annually	29 (4.1)
Annually	124 (17.5)
Never	143 (20.2)

^a Column percentages are in parentheses.

The respondents were asked if their company periodically conducts a formal performance evaluation and if the plans are reviewed and revised as a consequence of this evaluation. Eleven companies did not respond to this question, and some reported more than one frequency. In these cases, only the most frequent review period was recorded. It is evident from Table 7 that quarterly reviews are the most popular with 29.8% of respondents indicating this frequency of evaluation. However, a full 20.2% of small firms indicated that they never perform an evaluation. Approximately 90 percent of the firms that conduct these evaluations indicated that the plans are then reviewed and revised.

DISCUSSION AND CONCLUSION

The purpose of this study was to partially fill a void in the literature by examining the planning practices of small firms in the U.S., a population which has been largely ignored in past research. Because of the growing prominent role of these businesses in the economy, understanding the extent of their planning

efforts is a worthwhile research theme. This study focused on a subgroup of these companies – those in the manufacturing industry.

These results are important for several reasons. They indicate that the planning practices of smaller businesses may be more sophisticated than generally perceived. Almost 86 percent of the responding companies reported that they do prepare some type of written plan, and approximately one-half prepare formal plans with long-term time-horizons. This finding is consistent with the results reported by previous researchers (Dreux, 1990; Muscetello, 1990). Much of the planning appears to be long-range as opposed to operational. Another important point is that the great majority of these firms identify at least one external factor that serves as input to their plans. National and international political and economic trends are examined by many of these firms.

All but 91 of those who developed a written plan established quantified objectives. Adding further encouragement is the fact that many of the plans being prepared by these small businesses contain some fairly sophisticated elements beyond simply setting objectives for sales. For example, one-third set objectives for capital growth and market share, while one-quarter develop objectives for earnings. More than 90 percent reported setting more than one objective. This is supported by previous research on larger firms in several major industries which found that most businesses pursue multiple quantitative objectives (Shetty, 1979; Schneider, 1990). The preponderance of these businesses pursues a growth strategy, and nearly 75% prepare specific plans to implement it. Eighty percent develop some type of pro forma financial statements, just under half seek the services of consultants or other outside sources in their planning process, and 37 percent use, on a regular basis, a computer to assist in planning. Nearly 80 percent conduct a periodic evaluation of their performance to detect differences between planned and actual performance, and revise their plans as a consequence of these evaluations.

On the negative side, just over one-half of these firms develop pro forma balance sheets and cash flow analyses. Also, a very small proportion (9.1%) develops a specific succession plan. This has been one of the most pervasive problems in small companies. In this study almost one-third are actively hiring and training key managers, yet less than 10 percent prepare any type of succession scheme in their written plans. This low percentage is supported by other studies that report the inability or unwillingness of the owners of small enterprises to plan their succession (Seymour, 1993; Welsch, 1993). Current owners tend to view this question as being far away into the future and therefore not pertinent at the present time (Bruce & Picard, 2006). Family members or key employees may be reluctant to delve into this matter because the founders wish to forestall difficult decisions and perceive such discussions as a sign of their mortality (Aronoff & Ward, 1992). Therefore, while this matter is especially critical for these firms, it is not surprising that so few address the problem, given the sensitive and personal nature of this issue. Although much of the research on succession has focused on U.S. firms, many small businesses in other countries face similar predicaments (see, e.g., Power, 2005). However, it is possible that many owners may have addressed this issue and perhaps developed specific succession plans but, fearing conflicts among would-be successors, are reluctant to disclose these plans (Bruce & Picard, 2006).

The results of this study call to attention additional areas of concern. Only one in five companies included population/demographic trends, personal family incomes, social/cultural trends, and labor/management relations in their written premises, while non-product technological breakthroughs are considered by about 1 in 10. It is interesting to note that while 86 percent stated that they are pursuing a growth strategy, only 80 percent of these companies develop specific plans and budgets to implement this strategy. Another interesting finding relates to the fact that nearly one half do not retain any consultants. This is quite surprising given the rapidly changing technological advances and the complexity of laws and regulations affecting business in general. Additionally, there is evidence that many small businesses tend to perceive the consulting services they do receive as having a positive impact (Nahavandi & Chesteen, 1988). Another issue concerns plans that extend beyond five years; less than 5 percent have such a long-

term horizon. However, all companies with a long term horizon have an exit strategy in mind. Finally, almost two thirds did not utilize a computer to assist in their planning. This high percentage is not surprising since researchers have found that smaller firms do not have the necessary expertise, the financial resources, and the required software and hardware (Peterson, 1996). Therefore, they tend to use subjective and simpler techniques (Smith, *et al.*, 1996). However, the importance of these tools will increase with growing business complexity and the necessity to gain and sustain a competitive advantage.

Although this study provides many important insights, the results raise additional research questions that merit further study. For example, to what extent does the planning practices of these businesses differ from those of large firms? Do these planning practices differ from those of family-owned firms? Does a firm's level of internationalization have an impact on its planning practices? Another interesting issue concerns the relationship between planning and performance. Is the performance of firms categorized as planners different from that of non-planners? Also, future research may need to address the role of the board of directors and its degree of involvement in the planning process. Studies that examined this issue focused mostly on large firms. Another question that arises from this research pertains to succession plans. Given the importance of this issue, future in-depth studies should provide possible explanations for the absence of such plans in nearly all (90%) of these businesses. A comparison of U.S. firms with their counterparts in other countries would be an interesting future research avenue. Finally, with the Presidential goal established of doubling exports in 5 years, are there differences between exporters and non-exporters?

This study is not without limitations. Future extensions should give thought to replicating it using different populations. For example, firms in other regions of the U.S. should be surveyed. An additional caveat concerns the generalizability of the results. A study such as this one focuses on many firms in one industry - manufacturing - thus ensuring a greater homogeneity among the companies. However, it opens a line of inquiry on whether these results are valid across other industries. Thus another study which is devoted to other industries would be a fruitful endeavor. Another cautionary note concerns the possibility of bias in the data provided by the companies in the sample. This cannot be completely ruled out however because self-report measures are indispensable in organizational research (Gupta & Beehr, 1982). Indeed, in certain research contexts, self-reports may provide more accurate estimates of population parameters than behavioral measures (Howard, *et al.*, 1980).

In conclusion, this study's major findings will hopefully contribute to efforts to focus the attention of researchers, business practitioners, and policy makers on the planning processes and the needs and challenges facing small firms. Potentially these companies can be formidable competitive forces both domestically and internationally as they often are nimble and can be the sources of technological innovations. Such findings should accelerate the search for ways to improve the capacity of small firms to remain competitive in the global marketplace.

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PROJECT MANAGEMENT: THE EFFECTS OF MANAGEMENT AND LEADERSHIP

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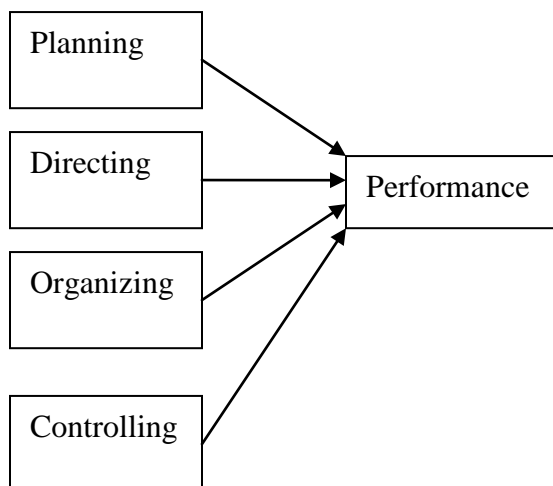
ABSTRACT

It is the purpose of this paper to investigate the consensus of the requirements imposed on project managers in balancing both the transactional leadership activities of managing a project while having to also provide the transformational leadership functions of directing and motivating the same project personnel (Bass, 1985). From a socio-technical perspective the transition necessary due to the advancement of technological changes in the administration of project management may be difficult on many levels. Individual's knowledge of the uses available through changes in technology can outpace the project manager's understanding of the advantages and disadvantages of the technologies. Teams may be able to take advantage of emerging technologies to obviate the need for excessive management or even team management itself (Guinan, Coopriider, & Faraj, 1998). Organizations may have a need to completely change direction in marketing, finance, accounting, and human resources due to advances in technology.

MANAGING TEAMS

Management is the predominate framework of the workforce today. The formalization of this framework began around the 1800's and culminated with the work of Frederick W. Taylor (Taylor, 1911). This philosophy presents management as a rational, linear, analytical process. This process includes the following steps; Planning, Directing, Organizing, and Controlling (Figure 1). Management is often presented as a transactional activity of maintaining the current status, rather than the transformational activity of developing people (Bass, 1985).

Figure 1. Management activities



Managing projects is difficult due to people's (teams) different disciplines, uncertainty in project scope, uncertainty in team member abilities and commitment, the influence of culture of the company, and according to recent research, the culture of the project management profession (Wang, 2001). Moving

Project Management: The Effects of Management and Leadership

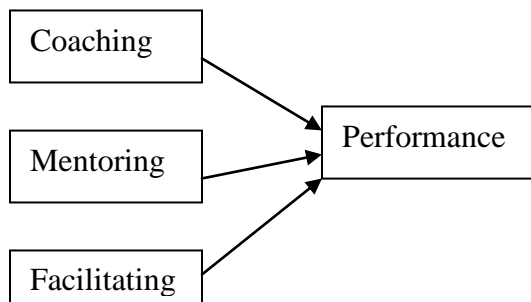
from a hierarchal culture to a clan culture can evoke issues with command and control during and after the transition. Management functions are highly effective in a hierarchal culture, whereas leadership functions seem to work better in a clan culture.

Not all work related tasks are best accomplished using the linear management model of Taylor's management process. Project requirements often cannot be achieved with the strict division of labor concept present by Taylor and that now are represented in the four activities of management. Leadership and specifically project management leadership concepts is becoming a common tool used by companies for achieving their competitive strategies and goals. Part of the competitive strategies and goals is to be innovative and creative in matching the process with the product in order to be more effective and therefore, cheaper, quicker, and better. Management functions may not be the most effective or efficient process to develop a creative or innovative atmosphere.

LEADING TEAMS

Leadership functions are often described as Coaching, Mentoring, and Facilitating (Figure 2). Current literature describes leadership as a transformational activity in a dynamic environment (Bass & Steidlmeier, 1999). Projects that are run as teams have a need to be able to organize the standard constraints of time, budget, and scope in a relational rather than linear structure (Hacker & Doolen, 2007). Using the construct of leadership as defined by Bass (1985) rather than the management functions described above is a means to incorporate relational structure.

Figure 2. Leadership



Managing projects appears to require the project manager to be adept at both styles of management, managing and providing leadership. However, both frameworks appear to have conflicting task or at least conflicts that complicate the role of managing. The issue is compounded by the advent of technology which can be used to make the management functions less important from a human perspective, yet more important from a leadership perspective.

SUCCESS FACTORS IN PROJECTS

Success factors for teams seem to fall into two categories which we classify as transactional and relational. Examples of transactional characteristics are planning, lines of authority, feedback (Hacker & Doolen, 2007), and technology tools (Guinan, et al., 1998). Relational issues include interaction with top management (Guinan, et al., 1998; Hacker & Doolen, 2007), culture (Wang, 2001), resistance to change

Project Management: The Effects of Management and Leadership

(Lucey, 2008), relationships with other departments and vendors (Hacker & Doolen, 2007), team skills (Guinan, et al., 1998), and commitment (Guinan, et al., 1998; Hacker & Doolen, 2007; Wang, 2001).

The use of a transactional leadership style (Bass, 1985) means that there is a very linear relationship between the manager and worker (Bennis, 2009). The managerial functions of planning, directing, organizing, and controlling are very linear and therefore make these functions susceptible to software engineering and decision analysis computer programs. However, the functions of a transformational (relational) leadership style of coaching, mentoring, and facilitating the workers will to produce do not lend themselves very well to technological solutions.

CONCLUSION

Project managers have to consider both transactional (managerial) activities of running a project while also providing the transformational (leadership) functions necessary to be successful. Transactional factors of a successful project lend themselves well to technological devices for the administration of project. However, team members' knowledge of the technology can replace the project manager's functions in running a smooth operation. Teams may be able to take advantage of emerging technologies to obviate the need for excessive management or even team management itself (Guinan, Coopriider, & Faraj, 1998). Consequently, Project managers and their organizations have a need to concentrate on leadership functions to become more effective in contributing to a projects success.

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**Understanding the Chaos behind Chaos Theory:
So What's in it for Managers?**

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Introduction

A butterfly flaps its wings in Brazil and later, the resulting air currents trigger a series of atmospheric events that eventually cause a tornado in Texas. Down deep, in the uttermost recesses of your brain, do you really believe that? Or, consider this question from Frederick (1998: 369). “Is the corporation a *self-organized complex adaptive system (CAS)* housing an *autocatalytic component*, operating on a *fitness landscape*, and exposed to the risk of *chaotic change* while being held in its niche by a *strange attractor*?” A ridiculous question or a thought-provoking inquiry?

To bring the butterfly phenomenon and the question from Frederick to the practical realm, we must consider this statement: “Increasingly, the quest for accurate prediction of even the short term is difficult. And the reason is that, in spite of how we believe them to be, virtually no social, political, or business systems follow straight-line paths of predictability. Rather, they behave in nonlinear ways because they are chaotic.” (Harris and Zeisler 2002: 21).

These statements focus on a radically different way of thinking from many of the “tried and true” paradigms that are used by managers in the practitioner realm. Their origins come from chaos theory and its close sister, complexity theory. Although ideas from this seemingly abstract field may initially seem extreme, they do have applications in business management.

Are managers operating in a chaotic business world? Certainly, open system theory describes the environment in which a business operates as containing various elements that are beyond the control of the business. For example, managers must address external variables (those that exist outside of the organization) such as competitor innovations, volatile economic conditions, government regulations, environmental changes, societal pressures and consumer preferences.

In this paper, we examine the components of chaos theory and their potential application to the managerial practice. We begin by describing the appeal of chaos theory among organizational researchers. Next, the basic components of chaos theory are explained. This paper concludes with potential perspectives that chaos theory can add to the practicing manager’s repertoire of tools.

The appeal of chaos theory

The bestselling book by James Gleick (1987) made chaos theory understandable to those outside the mathematical and physics disciplines. It was not long thereafter that social scientists, organizational scholars and psychologists found an interest in chaos theory. Finally, there was a framework based on nonlinear occurrences that could be used as a lens to understand the complex social and psychological interactions that make up these disciplines.

The past decade has brought an interest in the application of chaos and complexity theories as a lens for viewing the management of organizations (Burns, 2004). Such work has been seen in the fields of strategic management (Dervitsiotis, 2004; Hurtado, 2006), health care management, public management (Farazmand, 2003), marketing strategies (Mason & Staude, 2009; Samli, 2006), entrepreneurship (Mason 2006), product development (Closs et al. 2008), information system design (Dhillon & Fabian 2005), flexible procedures design (Brodbeck 2002), e-commerce (Nelson & Nelson 2004), organization design (Brodbeck 2002; Dolan, Garcia & Auerbach 2003), and the analysis of organizational crises (Crandall, Parnell, & Spillan, 2009; Sellnow, Seeger, & Ulmer, 2002)

Origins of chaos theory

Lorenz (1993) discovered the roots of chaos theory in his attempts to build a mathematical model to forecast weather during the early 1970s. With twelve linear equations containing a number of variables, he found he could predict the weather – but only some of the time. In his research, he found that

sometimes the model came up with very different forecasts, depending on the initial starting point of the forecast period. Even slightly different starting points would result in widely different forecasts. In other words, the results did not follow precisely repeatable cycles, despite the fact that the equations did not change.

At the same time, other scientists - mathematicians, physicists, biologists, social scientists, even economists - were running into similar phenomenon. They discovered the linear equations they were using did not capture the full explanation of what they were trying to predict; consequently, they were forced to conclude the events taking place followed nonlinear patterns. Inasmuch as linear equations were solvable and most nonlinear equations were not, these scientists faced a difficult task. They needed a new way to explain what was happening. Furthermore, they had to convince many in the scientific world that existing theories were not entirely useful. The problem was that they did not account for unexplainable or interfering variations; variations that had been previously regarded as "noise" in earlier studies. When these variations were small, they did not present a problem; however, in some cases, the variations caused major and unexplainable patterns. For example, in weather forecasting, a small variation in an atmospheric condition, can lead to a major change in the weather later on in the week.

The Characteristics and Components of Chaos Theory

Chaos theory finds its roots in mathematics and the natural sciences; hence, the term chaos must be identified within its proper context. Chaos is a state where phenomena that appear to be unrelated actually follow an unknown or hidden pattern called an attractor. Chaotic systems display two characteristics, sensitive dependence on initial conditions and unpredictability in the long run.

Sensitive dependence on initial conditions

Lorenz (1993) noted that a slight change in the initial input of meteorological data could lead to vastly different results. This now famous occurrence led to the popular butterfly effect referred to at the beginning of the paper. This effect states that the flapping of the wings of a butterfly creates tiny air currents that can begin a series of meteorological phenomena that can eventually lead to a larger event such as a hurricane in a specific part of the hemisphere. However, it should be pointed out that it is not so much the occurrence of the hurricane that is important to note; rather, the location of the hypothesized hurricane. In other words, should the butterfly flap its wings in a slightly different variation, the resulting chain of events could lead to a hurricane in a completely different location of the world, or perhaps, to a state of sunshine instead! This important characteristic of a chaotic system, sensitive dependence on initial conditions, thus illustrates that a slight change in initial conditions can lead to a vastly different outcome in the system under study.

Unpredictability in the long run

The second characteristic of a chaotic system is that the behavior of the system cannot be predicted in the long run. At best, only short-term predictions are possible. Again, the weather is an example of a chaotic system that defies long-term prediction (Lorenz, 1993). While we can certainly predict seasons and general patterns, we cannot predict the specific weather in terms of temperature and precipitation on a specific day of the year; say one hundred days from now.

A system in chaos thus contains these two characteristics, sensitive dependence on initial conditions, and unpredictability in the long run. The reader should note that such conditions actually describe a number of events that managers must address on a regular basis. Hence, there is some feasibility in stating that managers must manage in a chaotic system. However, we can also add several other components that help describe a chaotic system. These include bifurcations, attractors, nonlinear behavior, and self-organization.

Bifurcations

A bifurcation is a point in the behavior of a chaotic system where the outcome can actually vary between two possible values in alternating time periods. The biologist Robert May, made the discovery of a bifurcation while conducting a population model experiment (Gleick, 1987). May found, as he increased the parameter value in his model, the population would increase until it reached a bifurcation point. At this bifurcation point, the population would then alternate values on a two year cycle, reaching a certain value the first year, followed by a lower value the next year, then to return to the original value the third year, and so on. As the parameter was increased again, a new bifurcation point was reached. Now the population values alternated within a four-year cycle. As the study variables were increased again, still more new bifurcation points were encountered until the model reached a state where the value of the population could lie almost anywhere between extinction and a very large amount. The system was in chaos because the population did not seem to settle down to any predictable level.

Even while the system was in chaos, May continued to increase the study variable parameter. Interestingly, when a certain parameter value was reached, the system (i.e., the population level) settled back down to a constant three-year cycle. However, increasing the parameter again caused the system to return to chaos. In fact, the system continued to move in and out of chaos as the parameter level increased. Figure 1 illustrates a simplified version of this chaotic system with a series of bifurcations followed by the resulting regions of chaos.

Attractors

In chaos theory, an attractor is a pattern that forms when the behavior of a nonlinear system is plotted in phase space (Lorenz, 1993). Phase space depicts the different states of the system through various points in time. Such systems produce plots that can resemble orbits. Thus, the behavior of a chaotic system follows a pattern through time.

Attractors range from being fairly simple to vastly complex. Four types of attractors have been identified: Point, pendulum, torus, and strange. Point attractors depict a simple system that constantly returns to a single point. Pendulum attractors vacillate between two points. The torus attractor is a more complex pattern that forms an orbit. The strange attractor, sometimes referred to as a fractal, is a complicated pattern that exists when the system is in chaos. The most famous strange attractor is the Lorenz butterfly, which resembles the wings of a butterfly when graphed (not to be confused with the butterfly effect described earlier).

Nonlinear behavior

Linear systems react in a proportional or linear manner. The concept of linearity implies that a change in one variable will result in a proportional change in another variable. The result is that the relationship among the variables can be depicted as a straight line. Noting this relationship is important to managers because it means there is some degree of prediction possible using linear based models.

In contrast, the relationships in nonlinear systems depict variables that are not linear, but instead, may be curvilinear, u-shaped, s-shaped, or any combination of these. Since chaotic systems are nonlinear, they do not possess the predictability that linear systems have. Because much of the natural and social world behaves in a nonlinear fashion, chaos theory offers a suitable perspective in examining these systems (Smith, 2002).

Self-Organization

This component of chaos theory describes the system's ability to change itself into a new form without intervention from forces outside the system (Loye & Eisler, 1987). The concept posits that a chaotic stage is necessary first in order for a new system to emerge (Butz, 1997). Closely related to this component is the concept of a complex adaptive system (CAS), a term borrowed from complexity theory. This refers to the ability of an organization to adapt to its surrounding conditions in order to survive (Frederick, 1998).

There is another term we must mention at this point, a concept called “the edge of chaos”. This concept was not actually part of the original theory on chaos, but one that has been used by complexity theorists who were attempting to distinguish system behavior that was on the verge of, but not in chaos (Brown & Eisenhardt, 1997). Popular writers have found the phrase intriguing because it represents a crucial area of complexity where management creativity can be at its highest. Following this logic, the aim of management is to operate on the edge of chaos, without actually descending into it.

So what’s in it for Managers? – First, Two Caveats

There has been an abundance of enthusiasm for the use of chaos theory in business applications among those in both the academic and popular business media. However, several cautions are in order. First, some have advocated chaos theory to be a superior framework to more traditional linear models when analyzing organizational problems. Second, a number of writers have been guilty of semantic misunderstandings on the meaning of the term - chaos. Consequently, we offer the following two caveats in reference to these viewpoints.

Chaos theory has been over-enthusiastically endorsed as a “cure-all” in organizational research applications.

Chaos theory has been offered by some as a superior framework in the analysis of organizational events. The rationale touted is that most organizational problems transpire in a nonlinear manner; therefore, these problems should be analyzed using a nonlinear perspective (Farazmand, 2003). While there is some logic in this perspective, there is also the temptation to downgrade the linear approaches to forecasting and problem solving that have built up our knowledge in the business field over the past several decades. Much of the business and organizational research in management is based on these linear perspectives. To imply that chaos theory is somehow superior or exclusive means we must cast off the significance of previous research that used these linear approaches.

There is however, another problem with advocating the superiority of the chaos theory perspective - little empirical research in the management field is available that validates chaotic conditions. Instead, we must assume organizational life is nonlinear (and hence, capable of chaos) because we say it is. This leaves the management theorist/researcher and the popular press business writer in a bit of a quandary on how to use chaos theory at all. Thus, for the management researcher, the use of chaos theory is usually one of a metaphor, not a strict statistical tool that seeks to plot values in phase space. Indeed, the use of metaphors can be useful in understanding complex organizational systems (Morgan, 1997).

If we downgrade the application of chaos theory to a metaphor, does it mean it is no longer a superior framework to linear approaches to solving problems? Or, put another way, can chaos theory actually tell us much that cannot be explained with existing theories (Kincanon & Powel, 1995)? We believe chaos theory will add “some” unique perspectives to our body of knowledge on business and organizational life. It does provide a useful metaphor, but not necessarily a superior perspective that outclasses all other approaches. We offer that chaos theory is one of a number of tools and perspectives available to the organizational researcher and manager, but it is not one that should be assigned elevated status over any of the other perspectives.

There are significant misunderstandings of the word “chaos”, especially among popular business writers.

The most significant caveat that can be put forth in the context of this discussion is drawing attention to the apparent misunderstanding of the word chaos. Within the context of chaos theory, chaos refers to a system state characterized by sensitive dependence to initial conditions and unpredictability in the long run. However, some have used the more familiar definition, a state of being where events are random or out of control, to signify chaos. This comparison is incorrect (Kincanon & Powel, 1995) although one could see how the two definitions of chaos may be confused.

For others, the concept of chaos carries with it a sense of mystery and excitement about life (Stoppard, 1995). The appeal of chaos theory has been likened to a romantic appreciation of disorder that accompanies a corresponding reaction against the scientific appreciation for order and symmetry. One could further extrapolate that such a viewpoint advocates liberation from the constraints and bondage of a world obsessed with trying to bring order to every issue imaginable (Friedrich, 1988; Smith & Higgins, 2003). As we have pointed out though, this perspective is not consistent within the context of chaos theory.

So what's in it for Managers? – Three Perspectives to Consider

1. Managers should operate from the mindset that their organizations already exist within a chaotic system.

Open systems theory taught managers that their organizations exist within a larger system that exerts influences on the business, some of which are good, many of which are bad. We recommend this line of thinking be continued and not abandoned. However, chaos theory maintains that the organization exists within a system that ALSO has these two characteristics, sensitivity to changes in the initial conditions that the organization finds itself in, and, an inability on the part of the organization to make long-term predictions. Given this mindset, the application of a chaos theory perspective seems feasible.

What this means is that the organization continually finds itself within a system that is similar to meteorological phenomenon. Some days are certainly good days for the organization and life can be very nice, particularly when revenues are high, profits are being realized, and the economy is good. But all of that can change, and change substantially, with just a small jolt in the system. Certainly, the sub-prime mortgage crisis is an example of an initial condition in the economy that changed, causing a worldwide economic collapse. The point to remember is this – the system itself was already a chaotic system, even when times were good. A small change in initial conditions that produces big results is simply a characteristic of this system. Hence, the sensitivity to initial conditions.

Perhaps this example though is too familiar and simple to understand. Let's take another one that is less known. Industrial fires offer an example of events that are subject to sensitive dependence to initial conditions. In many of these accidents, a small, almost insignificant factor can serve as the trigger event that causes the fire to erupt. For example, under the right conditions, a concentration of dust can serve as a trigger event. Warner Lambert experienced such an event in November 1976, when a fire and explosion shook its chewing gum manufacturing plant in New York, culminating into a crisis that left six employees dead and 54 injured. The trigger event for the fire was thought to have been a stray electrical spark in the presence of magnesium stearate, a powdered lubricant used in the manufacturing of chewing gum (Sethi & Steidlmeir, 1997).

The concept of sensitive dependence on initial conditions maintains that the outcome of this event could have been dramatically different had something in the initial conditions been slightly different. For example, the stray spark was thought to have originated from a machine that was operating beyond its designed capacity, and, in close proximity to high levels of magnesium stearate dust (Sethi & Steidlmeir, 1997). Had the dust levels been lower, or had the machine been operating at its designed capacity, the explosion itself may have never occurred (Crandall, Parnell, & Spillan, 2010).

Examples abound of industrial accidents that were associated with sensitive dependence on the initial conditions of the system. The Exxon Valdez oil spill would have never occurred if the tanker had been on a course just a few meters away from the reef that it hit. In the tragic 1996 ValuJet Flight 592 crash, oxygen canisters were improperly loaded on the aircraft, which led to a fire in the cargo compartment. Unfortunately, even though cargo compartments are not supposed to have air available to feed a fire, the oxygen containers themselves provided the fuel necessary to escalate the fire, sending the airliner uncontrollably into the Florida Everglades (Greenwald & Hannifin, 1996). Aircraft successfully take off and land every day, but when an accident does occur, it is often because of a slight change in the initial conditions that sends the event into the accident case files.

A second assumption of operating within a chaotic system is that long-term forecasts are difficult, if not impossible. This is a hard assumption for managers, who, let's face it, are in the business of planning and controlling. Nonetheless, their job requires that they make forecasts, define goals and implement action plans, all in an environment in which they often have little control.

Consider this example to illustrate the problem in making long-term forecasts in a chaotic system. Many managers face a dilemma related to management by objectives (MBO). In theory, MBO sounds good - line managers and their superiors work together to arrive at operational goals. However, what often occurs is that their supervising managers tell the line manager what bottom line profits goals should be by the end of the fiscal period. The line managers must then "figure out" how to hit that goal. Because slight changes in the working environment can occur, the line manager may not be able to hit certain goals, even though the variables that have changed have nothing to do with the line manager's interventions. For example, raw material prices can escalate during the fiscal period. This raises product cost, which raises cost of goods sold, and suddenly, the forecasted budget is out of sync. In reflection, this observation is not an indictment against MBO, but simply recognizing that small changes in the initial state of the organization and its environment can make longer term planning difficult - a fact that practitioners already know from years of operating experience.

To compensate for this lack of ability to make long-term forecasts, some management theorists and practitioners advocate contingency planning. Contingency theory advocates moving away from simple point targets, to exploring a realistic range of possibilities that could occur - possibilities that we say are likely in a chaotic system. However, even contingency planning can suffer from its own problems with long-term planning. For example, should we plan for a range of contingencies 20% higher or 20% lower? But is 20% right, or should it be 25%? This type of thinking can cause managers to regress back to a point target mentality instead of thinking in terms of true range possibilities. Point targets (one number) are seldom correct; therefore, it appears that the targets should cover a reasonable range.

One other response to recognizing that the manager's world resides in a chaotic system is to devote more time to the practice of scenario planning. This type of planning allows for a range of possibilities, and often aims at planning for crisis events. For example, oil companies plan for interruptions of oil in case a war breaks out in a region of the world. This type of planning focuses more on a range of potential events, as opposed to a range of potential outcome targets, such as sales, expenses, and profit margins.

2. Operating in a chaotic system is a unique mix of stability (strange attractors) and flexibility (adaptation to the changing environment).

Technically, the strange attractor is a quantifiable phenomenon found in phase space. However, among management writers, the strange attractor is usually discussed as a metaphor when analyzing organizational life. Management researchers have assigned various descriptive to the strange attractor. Murphy (1996) relates several studies that identify organizational culture as a strange attractor, particularly when an organization experiences a crisis. Organizational culture generally refers to a set of beliefs and values embedded within an organization. For example, Johnson & Johnson's strong belief in a focus on the consumer has been identified as an example of a strange attractor during the Tylenol poisoning crisis in 1982 (Murphy, 1996).

In the organizational realm, Dervitsiotis (2004) identifies unique styles of management as attractors. Likewise, Frederick (1998) ascribes an organization's values as its strange attractor. From this perspective, values can be likened to an organization's culture discussed previously. In other words, it is the organization's values that hold it together while it is going through the turmoil of a crisis.

From the crisis management literature, Sellnow and associates examined the 1997 Red River flood in Minnesota and North Dakota from a chaos theory perspective. They proposed that the United States National Guard and Federal Emergency Management Agency (FEMA) were the strange attractors since both agencies were instrumental in bringing order to a situation that was in the midst of a crisis. Thus, Sellnow's viewpoint maintains that the strange attractor can literally bring stability to a situation that is in chaos (Sellnow, et. al., 2002).

The implication for managers is this; some stability is needed to maintain the integrity of the organization during difficult times. However, the stability implied by a strange attractor is not the same as maintaining the status quo. The status quo usually implies that a change is needed in order for the organization to move forward. Furthermore, there are times management must move the organization through the change process so it can re-adapt to its new environment.

For example, changes to the organization are usually inevitable when a crisis hits. From a manager's perspective, the concept of self-organization asks the question: how does the company look different from what it was before the crisis? The 1997 Red River Valley flood resulted in an array of self-organization for the political units involved in disaster relief for that area. Murphy (1996) maintains that within a chaotic system, changes will also occur in the organization's system, changes that create a new order with positive dimensions. Sellnow and colleagues discussed how the 1997 Red River Valley flood prompted a reorganization of emergency services between the adjacent cities of Moorhead, Minnesota and Fargo, North Dakota (Sellnow, et. al., 2002). On the positive side, the two cities were formerly rivals, but after the flood, cooperative structures emerged whereby crisis communication was centralized through Fargo's City Hall.

3. Operating on the edge of chaos is the norm, not the exception.

If we (as managers) assume that we are always operating in a chaotic system, then we no longer seek equilibrium as our goal, but instead, adaptation. With this assumption, we realize we are always operating on the edge of chaos. (Remember, chaos is simply that region within the chaotic system where we cannot make an accurate prediction, at all).

From a psychological viewpoint, the ability to function at the edge of chaos can spawn creativity and problem solving (Richards, 1996). Managerial writers have advocated that operating at the edge of chaos can be a good thing. The pressure it puts on organizations causes management to change the organization for the better or else die in the process. In fact, some note that organizations seeking to operate at a comfortable equilibrium may actually be in danger of failing in the long run (Pascale, 1999; Singh & Singh, 2002). Certainly, this is not a new observation by any means, as those in the strategic management field have been saying this very thing for years. What chaos theory does is to help us understand why this observation is true.

Brown and Eisenhardt (1998) have this to say about competing on the edge of chaos:

"Intense, high-velocity change is relentlessly reshaping the face of business in fledgling high-tech ventures and Fortune 500 giants, in steel and silicon alike. Everywhere, and in every industry, markets are emerging, closing, shrinking, splitting, colliding, and growing – and traditional approaches to business strategy are no longer adequate. To thrive in these volatile conditions, standard survival strategies must be tossed aside in favor of an entirely new paradigm: *competing on the edge*.

Competing on the edge is an unpredictable, uncontrollable, often even inefficient strategy, yet a singularly effective one in an era driven by change. To compete on the edge is to chart a course along the edge of chaos, where a delicate compromise is struck between anarchy and order. By adroitly competing on these edges, managers can avoid reacting to change, and instead set their own rhythmic pace for change that others must follow, thereby shaping the competitive landscape – and their own destiny."

In his classic bestseller, Christensen (2000) suggests successful companies may be the most reluctant to change, because they believe what they are presently doing is what made them successful. As a result, they may suffer when their entrenched or "sustaining" technology is replaced by "disruptive" technology from a new competitor. He suggests that disruptive technologies rarely make sense during the years when investing in them is most important; consequently, conventional managerial wisdom at established firms becomes an entry and mobility barrier that entrepreneurs and investors can count on (Christensen, 2000).

Operating at the edge of chaos implies that with no equilibrium to retreat to, management must assign themselves the task of adapting and working through critical points in the organization's history. Andrew Grove, CEO of Intel, strongly supports the need to manage in turbulent times in his book *Only the Paranoid Survive, How to Exploit the Crisis Points that Challenge Every Company and Career* (1998). He describes how strategic inflection points must be confronted and managed during the life of a company. If managed correctly, strategic inflection points can be an opportunity for growth and success (at least until the next strategic inflection point occurs); if managed incorrectly, it can mean the demise of a company. He recalls the crisis faced by Intel during the 1980s when they struggled with the decision to vacate their strong position in memory chips and move more aggressively into microprocessors. Grove points out other strategic inflection points – superstores replacing neighborhood stores, talkies replacing silent movies, shipping containers replacing stevedores, and wireless communications replacing landlines. He stresses that strategic inflection points are difficult to identify ahead of time, especially for successful companies and suggests that top management listen carefully for early warning signs of change, both from within their company and from external sources.

Toyota's current experience with recalls is evidence that situations change dramatically, often seemingly arising from a small change in initial conditions that was not initially considered to be a major event.

Conclusion

As we write this paper, we can't help but think of its possible relationship with chaos theory. If we had written it a week ago, or a week from today (initial conditions), would it have been almost the same or would it have been significantly different? Would our thought patterns (unpredictable but within a given framework) have led to a somewhat different emphasis? Also, let's ask the obvious question, would this same exact paper, be rejected (or accepted) if sent to another meeting, where a different set of reviewers are utilized? (Note the change in initial conditions.) Most certainly, we have all experienced that; papers rejected at one meeting, were later accepted at another meeting, with the only change being a different set of reviewers.

As for the fate of THIS paper, we leave that in the hands of our current capable reviewers, who no doubt, are themselves operating on the edge of chaos, confronted with the potential bifurcation of accept or reject, (within the parameter of some undisclosed strange attractor of course).

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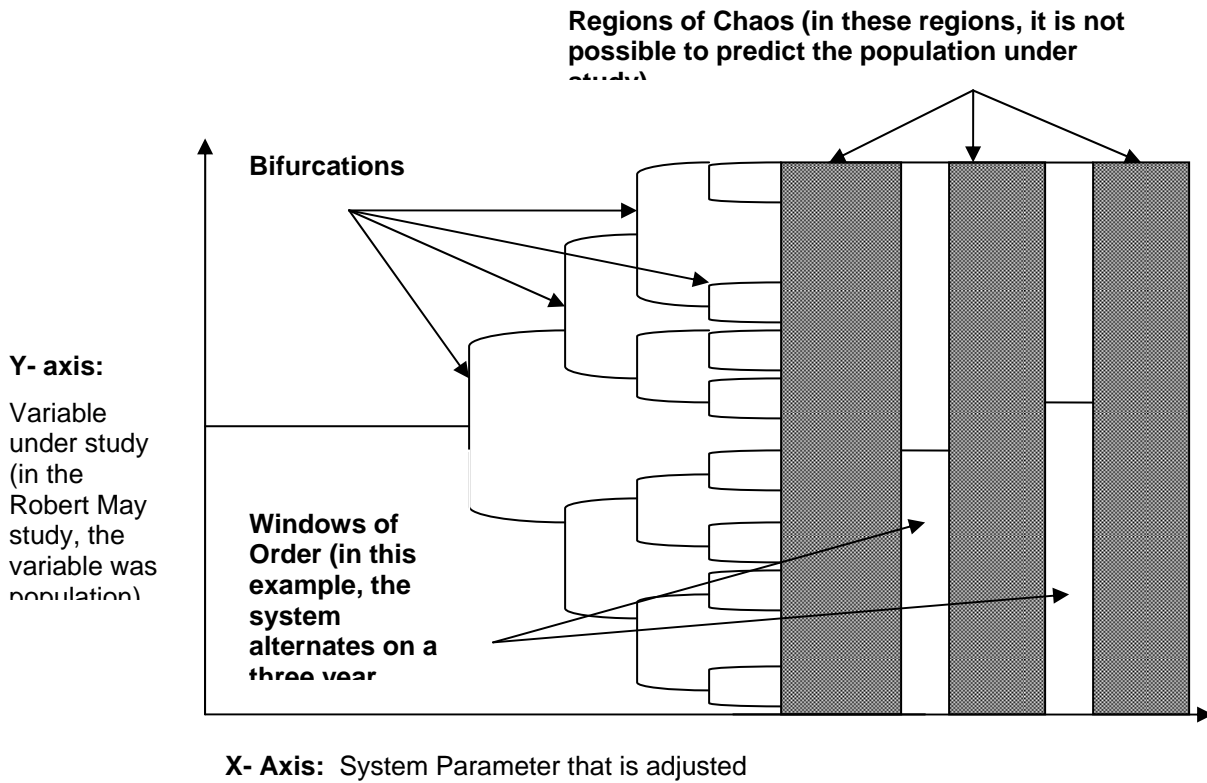
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Figure 1 – A Bifurcation Diagram illustrating the Onset of Three Regions of Chaos



Adapted from Crandall, W.R., Parnell, J., & Spillan, J. (2010). *Crisis Management in the New Strategy Landscape*. Thousand Oaks, CA: Sage Publishing, page 222.

Telework and Professional Isolation: The Role of Social Networking

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Abstract

The workplace environment is changing as organizations look for creative and agile methods of staying competitive (Chafkin, 2010). With this in mind more and more organizations are choosing to adopt telework and virtual organizations as one creative approach to achieving this goal (Chafkin, 2010). One report from Gartner Dataquest reported an increase from 11 million in 1999 to 34 million Americans who are currently working from home. As virtual organizations and telework continue in popularity, there is a need to address telework issues that may impact the telework experience. This research seeks to explore the relationship between professional and social isolation and teleworkers who work away from the office. This is an exploratory study which uses theory from social identity theory, technology acceptance model and interactivity theory. This research can be valuable to organizations seeking to increase or improve telework environments or for people working in virtual teams or in the development of organizational social networks that will be used for outside workers.

Key words

Social Networks, Virtual organizations, telework, telecommunication, technology acceptance model, social identity theory

Introduction

The workplace environment is changing as organizations look for creative and agile methods of staying competitive (Chafkin, 2010). With this in mind more and more organizations are choosing to adopt telework and virtual organizations as one creative approach to achieving this goal (Chafkin, 2010). One report from Gartner Dataquest reported an increase from 11 million in 1999 to 34 million Americans who are currently working from home. But are these employees dissatisfied with their work situation in terms of their professional development? Are they feeling isolated and displaced from other co-workers, customers and suppliers? And if so, can the use of social networks help alleviate the perceptions of isolation? There does not appear to be any previous research on social network and professional isolation. This exploratory research examines telework and professional/social isolation and whether the use of social networks can help reduce this isolation by presenting a conceptual model and proposed study focusing first on interviews followed by the use of surveys.

This research may help organizations in terms of training, recruitment and retention of teleworkers. Disabled or retired workers as well as other workers associated with brain drain may be more inclined to continue working for a firm if the telework environment is satisfying and rewarding. It may help in the planning and development of virtual teams

and virtual organizations or the development of social networks associated with teleworkers.

There is a difference in the richness of the interaction in face-to-face communication versus computer-mediated communication such as email (Daft & Lengel, 1984, 1986; Williams & Christie, 1976). The telework environment is different from the traditional environment in regard to interaction and communication. Currently, there does not appear to be previous research that evaluates the telework relationship in terms of professional isolation and social networks. The paper is organized in the following way: first a literature review is provided which supports the research topic; second the model and constructs are presented, third a discussion of the proposed study is given.

Literature review

Virtual Organizations, Telework and Social Identity theory

Social identity theory

As organizations embrace virtual organizations and telework, more employees may experience feelings of isolation and not being connected to the rest of the organization. Social identity theory (Tajfel and Turner, 1979) helps in understanding how people feel when they feel they are discriminated against within a group because of lack of social identity with the group. When individuals feel they are not part of the group socially, they feel their development can be hindered. In the case of teleworkers working in a virtual organization, their feelings of social and professional isolation may lead them to feel they are missing out on job promotions and career opportunities.

Furthermore, since virtual organizations and teleworkers involve remote work, away from a traditional office the issues associated with social identity may be a consideration in managing and working in a telework environment. Virtual organizations are organizations where all employees perform work-related jobs outside the office and there is not a brick and mortar office building for employees to physically access. Virtual organizations involve use of telework, telecommunications and computer systems in interacting with others inside and outside of the organization.

As organizations become more distant and globally dispersed (Reich, 2001), the challenges and issues associated with telework and virtual organizations will become more important. Employees and their online interactions and telework relationships will become important considerations. Will the employees be less happy and less productive in the telework environment? Will employees feel less connected and more isolated and therefore dissatisfied with the telework environment?

As such, employees may or may not be receptive to working in a partial or full telework situation depending on their perceptions of this environment in terms of their ability to

stay connected and communicate with other employees, customers or vendors. In addition they may miss the face-to-face interaction. They may feel the technology-enabled interactions may be insufficient and leave them feeling that they are isolated from others in the company such as their managers and co-workers and therefore are missing important information or passed over for promotions or other job-enhancing opportunities.

Previous research findings report that professional isolation is a concern for teleworkers in public and private organizations (Cooper & Kurland, 2002). Our research questions focus on the telework environment and teleworkers and the relationship between social networks, and professional isolation. Is professional isolation a concern of teleworkers? Does social networking help reduce the perceptions of professional isolation?

Telework/telecommuting

The term Telework/telecommuting was first introduced in 1975 by Nilles (1975) and became very popular in the 1980's with the rise of oil prices and other economic problems. Telecommuting has been described as any work done outside of the workplace where telecommunication and/or computer-based technologies are used (Bailey and Kurland, 2002).

However, today as companies are aggressively pursuing creative methods of sustaining agility and competitiveness, telework is enjoying renewed interest. One reason for the renewed interest is the grueling economic challenges that exist today and continue to persist in conjunction with steady and continuous improvements in information and communication technologies. Some organizations are adopting a combination of telework and in-office work where they are allowing some employees to work at home while other firms are going totally virtual, where all employees work outside the office and there is no brick-and-mortar office building.

Telework may help employees by reducing interruptions and allowing them to focus on one task. It can reduce commuting time and save gas and reduce traffic and traffic accidents, employers save on office space and equipment, flexibility with work and family schedules (Bailey and Kurland, 2002).

Social/Professional Isolation

However for all the benefits associated with telework, there are some areas that can be problematic. For one, many employees feel disconnected from the organization due to lack of human contact. Findings from previous studies indicate many teleworkers

experience feelings of social and professional isolation, (Tomaskovic-Devey & Risman, 1993; Bailey and Kurland, 2002). Social isolation is when workers feel disconnected from the informal, day-to-day contact and information from co-workers. Professional isolation, which is associated with employee development (Bailey and Kurland, 2002) is when workers feel they are out of sight and forgotten by managers and others and feel their chances for career growth and development such as promotions and job opportunities suffer.

Drawing on previous work from (Bailey and Kurland, 2002) we focus on three areas of professional isolation which can impact formal and informal (day-to-day) development. Three areas of development include: interpersonal networking, informal learning and mentoring.

Interpersonal networking - informal interactions such as office and work-related gossip, impromptu discussions which help establish relationships and office politics.
Informal learning – impromptu skill building or informal knowledge sharing that can occur in the office

Mentoring – experienced workers work with less experienced workers to help in career and skill development.

Social Networking

Therefore, professional isolation may leave employees unhappy with their telework environment. The use of social networking may help as a way to encourage a richer level of interaction and connection with co-workers and other work-related individuals.

As social networking continues to grow in popularity, more varied uses of social networks are being explored by businesses as well as individuals (Hempel, 2009). For example social networks are being used more to communicate with employees to encourage organizational interaction and information sharing such sharing human resource information; training and development virtual teams, and group collaboration.

Social networking may help reduce feelings of isolation which lead people to feel they will be left out and may miss out on important knowledge as well as opportunities for promotion because they are no longer in the in-group because they are working outside of the traditional office environment. The Technology acceptance model and the perceived interactivity theory are used in this research to help explain why social networks may help with social and professional isolation.

Technology Acceptance Model (TAM) – The technology acceptance model is based upon the theory of reasoned action which helps explain technological factors associated with the use of social networking websites. TAM argues that an individual's use of a technology is influenced by their perceptions of the usefulness, usability, and ease of use of the technology.

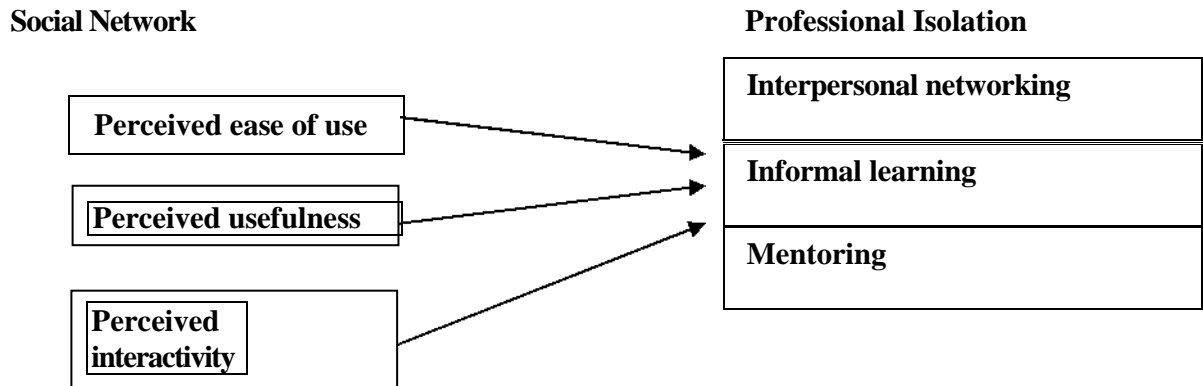
Perceived Interactivity theory

Social networks involve online interaction. Social networking sites allow interaction or communication in a one-to-one or one-to-many online situation. The perceptions associated with interaction using the websites relating to communication and quality of

the message may impact the use. According to telepresence theory (Steuer, 1992) and interactivity theory (Rafaeli,1988), the message and the mediated environment are associated with perceptions of interactivity.

Model

Previous research regarding Technology acceptance model argues that attitudes toward technology will affect the use of the technology. We posit that there is a positive relationship between the use of social networking sites and social/professional isolation. The conceptual model presented was developed to help explore the relationship between the use of social networks and professional and social isolation.



Constructs:

Professional/Social isolation

Interpersonal networking - informal interactions such as office and work-related gossip, impromptu discussions which help establish relationships and office politics.

Informal learning – impromptu skill building or informal knowledge sharing that can occur in the office

Mentoring – experienced workers work with less experienced workers to help in career and skill development.

Perceived ease of use – the degree to which the user expects the social networking site to be free of effort

Hypothesis1: perceived ease of use of social networks and professional isolation has a positive relationship.

Perceived usefulness – The degree to which the user expects the social networking site to be useful in job-related tasks and assessments.

Hypothesis2: perceived usefulness of social networks and professional isolation has a positive relationship.

Perceived interactivity – relates to communication, control, and responsiveness of the social networking site.

Hypothesis3: perceived interactivity of social networks and professional isolation has a positive relationship.

Methodology

In this study we plan to evaluate the telework environment regarding professional isolation and social networks by first interviewing 10-15 teleworkers in different fields. The information from the interviews will be used to enhance the conceptual model. Second, after the interviews are evaluated a survey will be developed based upon responses to interview questions.

Summary

In conclusion, as virtual organizations and telework continue in popularity, there is a need to address telework issues that may impact the telework experience. This research seeks to explore the relationship between professional and social isolation and teleworkers who work away from the office. This is an exploratory study which uses theory from social identity theory, technology acceptance model and interactivity theory. This research can be valuable to organizations seeking to increase or improve telework environments or for people working in virtual teams or in the development of organizational social networks that will be used for outside workers.

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- World at Work and Work Design Collaborative, Flexible Work Arrangements for Nonexempt Employees”*

GREED, A POSSIBLE EXPLANATION FOR THE INDIVIDUAL'S RESPONSE TO OVERPAYMENT?

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ABSTRACT

“Greed” is the often heard response to information that describes the high level of compensation received by some executives. While cries of “Greed!” may be emotionally satisfying, alternative explanations for the high level of compensation can be provided by experts in several fields of study. For instance, economist may explain the level of compensation as the result of supply and demand and compensation managers can explain the pay level as the consistent with the industrial average. It is necessary to recognize, however, that some of these explanations (e.g., industrial average) reflect the summation of all individual executive compensation contracts and that the demand for higher pay in each contract is initiated by the individual executive. Consequently, it is important to ask whether the individual’s request for higher pay is based on greed. This is especially true if the employee is considered to be overpaid. The present paper will attempt to address the question of whether greed may be an explanation for the overpaid employee’s pay demands.

INTRODUCTION

Today, pointed and severe questions and criticism are often heard as part of discussions of executive pay. However, this is not a new issue. Frydman [9] suggests that early in the 20th century secrecy surrounding executive pay prevented such attention. As a result, it seems that awareness of excessive executive pay began to emerge when information about executive compensation became public as a result of governmental management of the railroads during WWI.

Almost 100 years later, executive compensation remains the topic of many stories in today’s newspapers and television and radio broadcasts. Because many of these stories stress the difference between the pay received by the average employee and executive, they appear to be designed to stimulate an emotional response. While reports in academic journals point to these same pay differences, the focus of most of these articles is to investigate how and why these differences occur.

One justification for increased executive pay is based on the assumption that increased incentives in the form of bonus and stock options are necessary to motivate the executive. Such incentives have been popular since the early 1990s and appear to be based on the premise that executives must be offered such incentives in order to increase stockholder wealth (e.g., [13]; [14]). It is also thought [23] that executive pay is excessive because there is little confidence that the board of directors can truly engage in an arm’s length

contract negotiation and, as a result, many contracts fail to produce the desired increase in stockholder wealth [1].

It is, however, suggested that executives are not overpaid because their pay simply reflects supply and demand in the marketplace [15]. Others, however, posit that not only are executives overpaid, but the cause for the high pay level is the increased involvement of compensation consultants [2]. Consistent with this position, it is argued that organizational governance is too weak, which results in unrealistic compensation contracts [23]. Often these disagreements appear to take on a personal tone [23], but the lack of agreement might be best explained by the lack of data or inaccurate and incomplete data that prevents the development of a generally accepted theory that explains the observed increases in executive compensation [9].

Contracts are with Individuals

The above discussion describes a continuing disagreement as to the cause of increased executive compensation. Regardless of the point of view (e.g. market forces, weak governance, compensation consultants, etc.), the one common aspect is that each is ultimately based on single compensation contracts and the cumulative effect of all single contracts. To better understand executive compensation, it is necessary to understand the basis for the executive's demand for pay.

According to Shleifer [19], searches for executives occur in an efficient market, but the competitive arena for executives, as measured by increased stockholder wealth, is inefficient. As a result, stockholders and boards of directors are motivated to hire and retain executives who appear able to manipulate these market inefficiencies. Under these circumstances, it is reasonable to assume that the board has no clear understanding of the basis for the success of such manipulations; consequently, an executive has the potential to demand compensation contracts that simply reflects his or her self-interest.

It is thought that one dimension of self-interest is greed [21] and that greed may be a function of the fear of loss [18]. Greed as it is associated with self-interest both provides a mechanism for the definition of self and operates to mitigate loss by obtaining objects that may be used by others to satisfy their greed. This behavior appears consistent with reactive egoism or self-serving behavior to counter the supposed self-serving behavior of others [7]. As a result, self can be validated by the acquisition of material outcomes desired by others. Such validation, however, requires the continuous acquisition of increasingly valuable material outcomes, but does not appear to result in satisfaction [18].

To begin a development of an understanding of overpayment and the possibility that greed may be a possible explanation, it is necessary to address the question raised in the above discussion. That is, "Why, with increasing levels of compensation, is there little or no increases in satisfaction, but there are still demands for even more compensation?" The following discussion will attempt to address these issues, which will serve as the basis for investigating the overpayment question.

Increased Pay, Constant Satisfaction

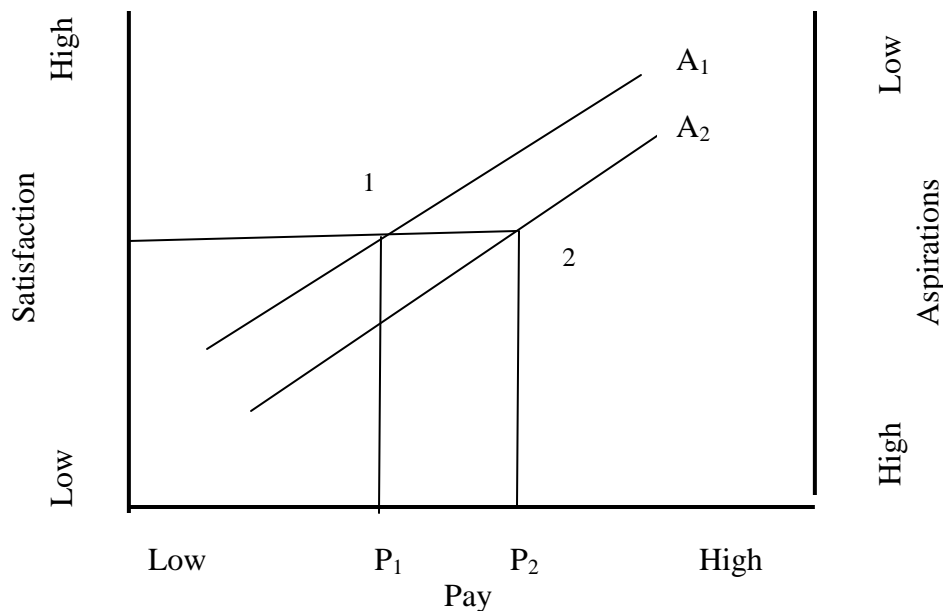
Easterlin [6] provides a possible explanation for why increased income is not accompanied by increased satisfaction. Easterlin [6] suggests an individual's immediate satisfaction reflects the decision utility related to the selection of one, among a number of competing, alternatives. However, he posits that experienced utility is of more importance in the determination of satisfaction because it reflects the positive or negative consequences of the all previously selected alternatives.

Since experienced utility serves as the cumulative representation of all previous decision outcomes, it serves as the foundation of the theory. However, experienced utility is subject to the influence of any number of time-based events and attitudes, especially material aspirations (hereafter: aspirations). In essence, Easterlin [6] posits that increased positive experienced utility will be accompanied by increased levels of aspirations.

The proposed relation among pay, satisfaction, and aspirations are shown in Figure 1. Basic to Easterlin's [6] theory is that as pay increases from P_1 to P_2 , Aspirations will reflect a similar increase (A_1 to A_2) that holds relatively constant (intercept point 1 compared to 2) the level of satisfaction. Consequently, across time, the hypothesized result in a relatively constant level of satisfaction.

Figure 1

Pay, Pay Satisfaction, and Aspirations*



*Adapted from Easterlin, R. A. (2001). Income and happiness: Towards a unified theory. *The Economic Journal* 111(July), 473.

Easterlin's [6] theory is supported by his analysis of national survey data relating pay and age with happiness. Based on cohort analysis, pay and age reflect a positive relation; however, happiness reflects a relatively constant value. The relative constant value exhibited by the measurement of happiness is, according to Easterlin [6], the result of increased aspirations. Easterlin's [6] theory and these reported results appear to be consistent with the above discussion of greed suggesting that the acquisition of additional valuable outcomes contributed little to the individual's satisfaction.

Regardless, I Want More

If, as noted above, the acquisition of additional valuable outcomes may not be associated with increased satisfaction, why do individuals continue to seek or demand increased outcomes? As noted earlier, such demands may reflect the individual's efforts to satisfy some dimension of self-interest [21] or in the extreme to attain some idealized self-image [22]. A number of explanations might be offered for the emergence of greed (e.g., [8]): people may be inherently selfish, the desire to continue their genes; focus on personal gratification; lack of social interest; etc.; and Wachtel's [21] infants' fantasies, weak self-esteem, etc.). However, at some level, there seems to be agreement that greed is associated with the fear of loss and that greed cannot be satisfied (e.g., [3]; [7]; [18]; [21]).

Easterlin's [6] position that aspirations suppress the ability of positive outcomes to increase an individual's satisfaction suggest that aspirations reflect greed or at least includes a greed component. Levine [18] notes that the concept of desire (aspiration) is a component of human nature and, in general, will lead to some higher level of satisfaction. However, if desire does not lead to increased satisfaction, it can be assumed that desire has been replaced by greed, which is focused on avoiding frustration or the fear of loss. As a result, in the present study, it is reasonable to assume that aspirations, as defined by Easterlin [6], can be viewed as a measure of greed.

THE PRESENT STUDY

It is reasonable to conclude that in today's consumer environment most of our needs, desires, or wants are simply converted to the common denominator: "dollar." [21]. The acquisition of "dollars" for most individuals is through the pay they receive and it might be concluded that the individual's satisfaction with pay would be simply based on the number of dollars received.

It is necessary to recognize, however, that the pay an individual receives does not provide an adequate basis for the evaluation of pay satisfaction. In essence, a more robust explanation requires the inclusion of a number of possible comparisons (e.g., alternative jobs, peers' pay, amount of work done, etc.) [17]. These several comparison allow for a determination of pay equity, which, regardless of how measured, is considered as a significant predictor of pay satisfaction [4]; [11]; [16]; [5]; [20]; [24].

Jaques' [12] compensation theory provides a direct method of establishing pay equity based on the demands of the assigned work, the employee's capacity to do the assigned work, and the pay received. Multiple comparisons among the three variables provide evaluations that provide a complete description of the various situations faced by the employee. Only two situations are to be considered in the present paper; therefore, a complete description of the theory will not be offered here.

Jaques' Equity Theory--The Basics

Jaques [12] uses three variables to determine equity. The variables are: time-span of discretion; time-span of capacity; and pay. Time-span of discretion (W) is described as "...the time period during which marginally substandard discretion could be exercised..." (p. 99). Time-span of capacity (C) is defined as "The capacity of individuals to carry responsibility by exercising discretion on their own account..." [12, pp. 186-187]. Pay (P) might seem to be the simplest of the three variables because it is defined as all direct monetary payments plus fringe benefits and subsidies [12, p. 125].

The Pay variable, however, is more complex because it represents a comparison of the individual's pay to a pay norm. This pay norm is "...an unrecognized system of norms of fair payment for any given level of work, unconscious knowledge of these norms being shared among the population engaged in employment work" [12, p. 124]. As a result it is necessary to determine if the received pay is equal, less than, or more than the pay norm. This comparison to the pay norm can be represented as $P_{=PN}$ (Pay is equal to the Pay Norm). By using =, <, and > symbols, the three comparisons can, respectively, be described as equal to, less than, or greater than the pay norm.

Presentation of the equity model is made easier by the using letters to represent the three variables as follows [12]: W-Work (Time-span Discretion); C-Capacity (Time-span Capacity); and P-Pay (all aspects of compensation). Of the possible P:W:C relations created by the symbols =, <, and > only one comparison is defined as equity (e.g., $P=W=C$). These representation must be expanded, however, to include the Pay:Pay Norm comparison, which is limited in this paper to $P_{=PN}$ (at the pay norm) and $P_{>PN}$ (above the pay norm).

For the purpose of this paper it will be accepted that an employee is assigned work (W) that is consistent with his/her capacity (C), that is $W=C$. As a result the employee will make an equity evaluation when the pay comparison is within $\pm 3\%$ [12] of the pay norm, which is illustrated by: $P_{\pm 0.03PN}=W=C$. It is thought that an equity evaluation is associated with the highest level of satisfaction and performance [12]. However, both pay below the pay norm (underpayment) and above the pay norm (overpayment) result in attitudes and behaviors inconsistent with optimal organizational performance [12]. Of special interest here is overpayment ($P_{>PN}=W=C$).

Feelings of overpayment result when the pay comparison is 5% above the pay norm ($P_{0.05>PN}=W=C$) and causes the employee to think that his pay is better than that of other similarly qualified and assigned employees. If the pay comparison is 10% or more than

the pay norm ($P_{.10 > PN} = W = C$), the employee, with no explanation for the overpayment, begins to worry that the overpayment may not continue. As a result the employee will not include the overpayment in his/her consumption plans, but will exhibit relatively high levels of satisfaction [12].

Consistent with the above discussion of greed, Jaques [12] suggests that a continued overpayment of 10% or more has the potential to stimulate "...greed and avarice..." (p. 133). Importantly, he notes that the overpaid employee may seek additional compensation that increases the level of overpayment.

The above discussion serves as the basis for the research questions (RQ) noted below. An investigation of these RQs may provide information useful in understanding the relation between overpayment, satisfaction, and aspirations and by extension, greed. The first RQ investigates Jaques' [12] position that the equitably paid employee will exhibit the highest level of satisfaction, but that the overpaid employee will also exhibit high levels of satisfaction.

RQ₁: Will both the equitably paid and overpaid employee exhibit high levels of satisfaction and will the satisfaction level of the equitably paid employee exceed that of the overpaid employee?

Easterlin [6] suggest that aspirations change across time and are influenced by any number events and situational variables. Thus:

RQ₂: Is the employee's pay condition (overpayment or equitable payment) a situational variable that influences the employee's aspiration level?

And:

RQ₃: If the equitably paid and overpaid employees are contemplating a promotion, will their aspirations for pay be equal to that established in RQ₂ and will the aspirations of the two employees be similar?

METHOD

Data were collected by the use of a questionnaire that included two situational descriptions (overpaid and equitably paid) and three identical questions for each situation are shown in Appendix A and Appendix B. The situational descriptions were written to provide sufficient information for respondents' to conclude that Work and Capacity are equal ($W = C$) for the two described employees. Information was include that while $W = C$, one employee was overpaid by 10% resulting in a $P_{.10 > PN} = W = C$ situation, while the second was at equity, $P_{=PN} = W = C$. This level of overpayment was selected because, as noted earlier, Jaques [12] suggests that this level of overpayment is sufficient to stimulate greed-based behaviors and attitudes.

Respondents were first asked to evaluate the satisfaction level of the overpaid employee and, later, to rate the satisfaction of the equitably paid employee. Respondents were then asked to record their opinion of each employee's pay aspirations in their present position. Finally, an evaluation of the employee's pay aspirations based on the hope for future promotion was requested.

As part of a larger study, these questionnaires were distributed in a MBA class at a regional state-supported university. The procedure produced 104 usable questionnaires, but for the purpose of this study the 17 respondents who reported no work experience were excluded. The analysis sample, $n=87$, consists of 38 females and 49 males. The average age for the respondents is 26.7 years and the average work experience is 5.75 years. No gender, age, or work experience effects ($p \leq .05$) were observed for the six questions (i.e., two Satisfaction questions; two Aspiration in present position questions; and two Aspiration with promotion questions). The means and standard deviations for the six questions are shown in Table 1.

Table 1
Means and Standard Deviations of Satisfaction and Aspirations Questions
under Two Pay Conditions

<u>Measure</u>	<u>Condition</u>			
	<u>Equity</u>		<u>Overpayment</u>	
	$P_{=PN}=W=C$		$P_{.10>PN}=W=C$	
	<u>X</u>	<u>S.D.</u>	<u>X</u>	<u>S.D.</u>
Satisfaction	.35	1.79	3.05	1.76
Pay Aspirations (Present Position)	4.89	6.26	8.51	7.59
Pay Aspirations (With Promotion)	7.47	8.17	11.26	8.22

RESULTS AND DISCUSSION

Data necessary to investigate RQ₁ show that respondents' evaluations of the overpaid employee's satisfaction level ($\bar{X}=3.05$, Table 1 and Appendix B) is greater than that of the equitably paid employee ($\bar{X}=.35$, Table 1 and Appendix A). The results of paired t-test, Table 2, show the two satisfaction values are significantly ($p \leq .000$) different.

The high satisfaction level for the overpaid employee is consistent with Jaques' theory [12], but the neutral satisfaction level reported for the equitably paid employee is not. However, since the satisfaction values reported for the equitably paid employee are

positive, the results are not sufficient to raise strong questions regarding the explanatory value of Jaques' theory [12].

Table 2

Paired-t Comparisons for Overpaid and Equitably Paid Employees*¹

<u>Measure</u>	<u>d.f.</u>	<u>t-ratio</u>	<u>p</u>
Satisfaction	86	10.80	.000
Aspirations for present pay	86	3.97	.000
Aspirations for pay accompanying a promotion	86	4.41	.000

*¹Values from Table 1.

The response to RQ₂ is based on respondents' determination that the overpaid employee would exhibit pay aspirations that are much greater (\bar{X} =8.51%) than that of fellow workers (Table 1 and Appendix B). This is considerably more than the aspirations, \bar{X} =4.89% more than that of fellow workers, for the equitably paid employee (Table 1 and Appendix A). A comparison of mean values (Table 2) shows the aspiration values are significantly different ($p \leq .000$). These results provide support for the inclusion of pay condition (i.e., overpayment and equitable payment) as a situational variable that influences aspirations [6]. These results are also consistent with Jaques' [12] position that the overpaid employee may demand even higher pay, which may reflect the emergence of greed attitudes and behavior.

It is necessary also to note that the equitably paid employee's aspirations (\bar{X} =4.89%) were for more than their fellow workers. Since Jaques [12] suggests that everyone will seek equitable payment, this may reflect desire [18] more than greed. That is, based on Levine's [18] distinction between desire and greed, it can be suggested that the equitably paid employee's aspirations are consistent with the concept of desire. As a result, the difference, 3.62, between the mean of the two aspiration values (Overpaid: \bar{X} =8.51%; Equitably Paid: \bar{X} =4.89%) can be considered as measure of greed.

Similar results can be observed in response to RQ₃. That is, respondents evaluated the overpaid paid employee's pay aspirations for pay coupled with a promotion (\bar{X} =11.26, Table 1 and Appendix B) as being much greater than that reported for the equitably paid employee (\bar{X} =7.47, Table 1 and Appendix A). As shown in Table 2, these values are significantly different ($p \leq .000$). These results appear to support promotion as a situational variable as it relates to aspirations [6] and supports the above information regarding the possible emergence of greed [12].

Analyses directed at responding to the RQ₂ and RQ₃ may not provide a complete picture of the effects of pay condition and promotion on aspirations. That is, while the absolute values shown in Table 1 are different; is the range of the aspiration levels for the overpaid and equitably paid employee also different?

The design of this study is not sufficient for robust data analyses, but additional basic analyses may provide useful information regarding the influence of a promotion on aspirations. Based on data in Table 1, paired-t tests (Table 3) were used to determine if the aspirations values at present pay and with promotion for the two employees were different. The results show that these values are significantly different. However, a comparison of the range of the differences between aspirations at present pay and aspirations with promotion (Overpaid: \bar{X} =3.62; Equitably: \bar{X} =3.79) shows no significant difference. Thus, while the magnitude of the aspiration values for the overpaid and equitably paid employee are significant different, a promotion appears to have a constant effect on the aspirations of the overpaid and equitably paid employee. It is reasonable to suggest, therefore, that promotion may not be a situational variable that influence aspirations.

Table 3
Paired-t Comparisons for Aspirations and Aspirations Differences for
Overpaid and Equitably Paid Employees*¹

<u>Comparison</u>	<u>d.f.</u>	<u>t-ratio</u>	<u>p</u>
Overpaid: Aspiration ₁ to Aspiration ₂ ^{*2}	86	2.991	.004
Equitable: Aspiration ₁ to Aspiration ₂	86	2.854	.005
Difference ^{*3} : OA ₁ -OA ₂ compared to EA ₁ -EA ₂	86	.171	.864

*¹Values from Table 1.

*²Aspirations₁=Aspirations at pay level. Aspirations₂=Aspirations with promotion.

*³OA=Overpaid Aspirations EA=Equitable Aspirations

CONCLUSIONS

As suggested by Jaques [12] the pay satisfaction for the overpaid employee was high, but, inconsistent with the theory, the equitably paid employee's satisfaction was judged to be only marginally satisfied. This suggests that efforts to "fairly" pay employees may not result in expected levels of pay satisfaction. Additional research is necessary to determine if "fair-pay-policies" provide the expected positive attitudes [10].

The results reported here suggest that pay condition (overpaid:equitably paid) is a situational variable that effects employees' aspirations for pay. These results are consistent with Easterlin's [6] theory, but the potential for promotion does not appear to influence the range of the overpaid and equitably paid employees' aspiration for pay. It must be recognized, however, that the methodology used in the present study limits the strength of the rejection of promotion as a situational variable. Consequently, evaluation of this conclusion requires additional studies.

Accepting that fear of loss [18] and self-interest [21] prevent increased levels of satisfaction, which is an indicator of the presence of greed, aspirations as defined by Easterlin [6] appears to provide a method of evaluating greed. That is, if the overpaid individual exhibits aspirations greater than that of the fairly paid individual, the difference can reasonably be attributed to greed (self-interest or fear of loss). The different aspiration levels reported here for the overpaid and equitably paid employee may serve as an indication of the emergence of greed on the part of the overpaid employee.

This explanation is consistent with Jaques' [12] suggestion that the overpayment, because of a lack of information as the reason for the overpayment, may stimulate greed. In addition, the explanation provides an important opportunity for additional research to determine the level of overpayment associated with the emergence of self-interest or fear of loss (greed). This is especially true because Jaques [12] suggest the overpayment level to be approximately 10%, which was used in this study. However, additional research is called for to determine the level of overpayment that begins to stimulate greed. Additional studies are necessary also to identify other situational variables (e.g. business category, competitive position, etc.) that may influence the emergence of greed attitudes and behavior.

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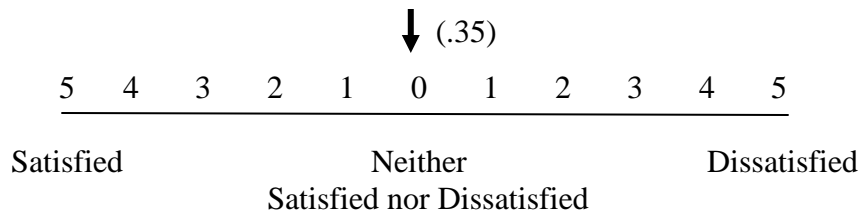
APPENDIX A

Questions and Mean Responses for Equitable Payment

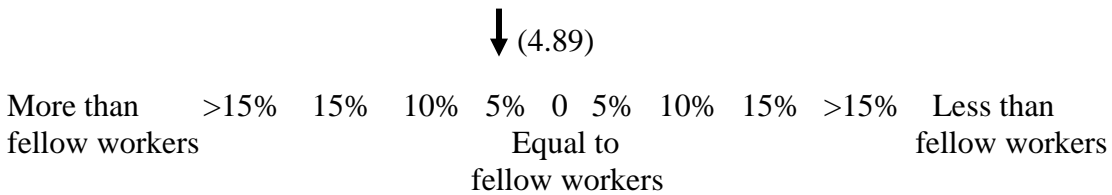
In the following questions you will be asked to evaluate the Pay Satisfaction and Aspirations of **Employee Thirty**, who is assigned to Work Team Ten. In responding to the questions, please remember that qualifications, performance, and quality of output of all employees assigned to Team Four are, for all practical purposes, the same.

The pay **Employee Thirty** receives is the same as the pay of the other employees.

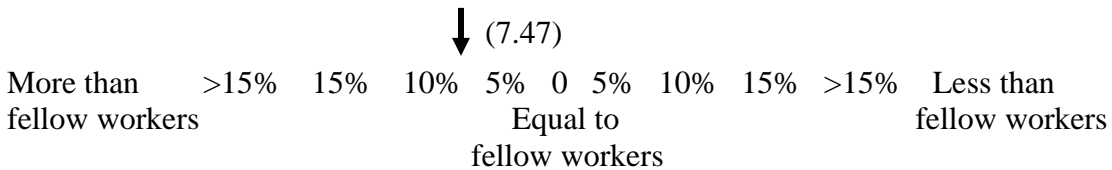
By circling a number on the scale below, please evaluate this employee's (Employee Thirty) level of Pay Satisfaction.



By circling a number on the scale below, please evaluate Employee Thirty's pay aspiration in the present job.



Employee Thirty hopes to receive a promotion to a senior position with greater authority and responsibility. Please circle the number on the following scale that you think represents Employee Twelve's pay aspiration in that senior position as compared to colleagues in similar senior positions.



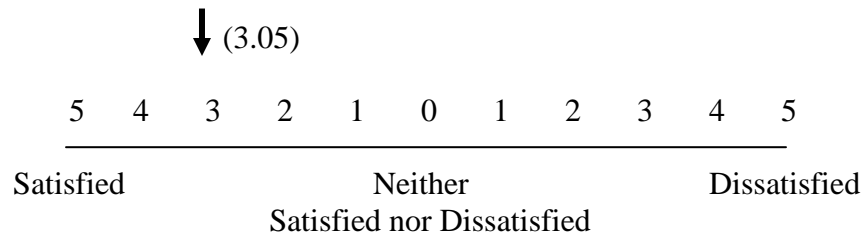
APPENDIX B

Questions and Mean Responses for Overpayment

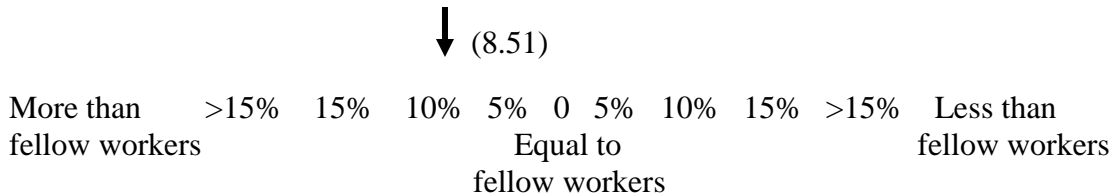
In the following questions you will be asked to evaluate the Pay Satisfaction and Aspirations of Employee Twelve, who is assigned to Work Team Six. In responding to the questions, please remember that qualifications, performance, and quality of output of all employees assigned to Team Six are, for all practical purposes, the same.

The pay **Employee Twelve** receives is 10% more than the pay of the other employees.

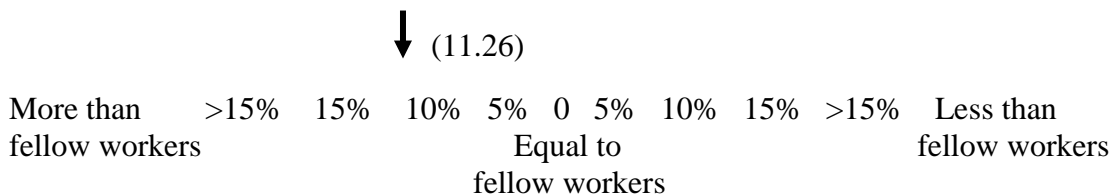
By circling a number on the scale below, please evaluate this employee's (Employee Twelve) level of Pay Satisfaction.



By circling a number on the scale below, please evaluate Employee Twelve's pay aspiration (wish, hope, desire) in the present job.



Employee Twelve hopes to obtain a promotion to a senior position with greater authority and responsibility. Please circle the number on the following scale that you think represents Employee Twelve's pay aspiration in that senior position.



Abstract

This paper addresses the call by Roth (1995a) "To what extent should brand image be customized or standardized to build and maintain brand equity?" By laying out a proposed empirically testable research model and developing research propositions based on the literature this paper presents a response to this call for research.

Globalization versus Standardization: Research Propositions Examining Global Marketing Strategy on Firm Performance

Introduction

The debate continues regarding market globalization. Academics continue to struggle to describe and define it (Levitt 1983; Jain 1989; Zou and Cavusgil 1996; Craig and Douglas 2000) and even disagree as to whether there is such a thing as a global organization since a relatively small set of multinational enterprises (MNEs) accounts for most of the world's trade and investment (Rugman and Verbeke 2004). While the goal of standardization is to achieve economies of scale, scope or learning curve, there continues to be studies exploring strategies for companies to decide the best way to enter markets.

The fact remains that many companies are choosing to operate beyond their home country for either resource, market or other value chain reasons. Once a company decides to sell internationally, marketing executives begin thinking about level of standardization regarding all aspects of products, marketing, packaging and branding communications. These marketing executives and managers, global brand "champions" and global brand teams must take various market conditions into account when considering to what level to standardize advertising as well as to standardize or customize their global brand image (Roth 1995; Aaker and Joachimsthaler 1999). Researchers have called for more research to address global advertising standardization, brand image and links to performance (Roth 1995; Roth 1995). Roth (1995a) specifically called for research that addresses questions in the area of

international marketing and asked, "To what extent should brand image be customized or standardized to build and maintain brand equity? (Roth 1995a)

Problem

Recent studies have started to address advertising standardization at the strategic level. When Griffith, Chandra et al (2003) looked at standardizing packaging and advertising message, results were mixed. The empirical support for standardization of advertising appears to be mixed because international business is still in transition, as the debate continues, so do the calls for research in these areas (Kanso and Nelson 2006).

Academics, like Fastoso (2007), have noted that the relationship between advertising standardization and firm performance was seldom studied and Okazaki, Taylor, et al (2006) called for researchers to validate their findings tying perceptions of advertising standardization to perceptions of firm performance.

Practitioner questions include: What considerations are senior marketing executives evaluating when making standardization of advertising decisions as part of the global marketing strategy in terms of strategy, execution, brand image and firm performance? Do the perceptions of senior marketing executives located at the headquarters of MNCs support their marketing goals as well as brand image and the perceived impact of standardization on firm performance and which elements contribute the most to the goals/firm performance?

This study will extend the work of Okazaki et al (2006) which measured subsidiary manager perceptions of culture and advertising infrastructure as well as IMC. It will attempt to clarify standardization of advertising using a corporate senior marketing

executives perceptions of culture and advertising infrastructure and a more robust, multi-item four dimensional scale to measure IMC (Lee and Park 2007). Further, the study also will examine uniform advertising strategy and uniform advertising execution (transformed mediating variable of standardization of advertising) and the mediating role of brand image to further empirically explore the standardization debate and identify which elements best predict a firm's performance.

The following sections will provide an overview of the academic literature on standardization, industrial organization and resource based view theories, and the standardization of advertising and the debate that surrounds it.

Literature Review

Standardization

Levitt (1983) strongly supports the notion that the world is becoming more homogenized because of the technological progress made in both communication and transportation. He further contends that when a company can source globally to produce high quality, low priced products, it is able to achieve a competitive advantage operating in the global market. To maximize the advantages of this strategy a company must also adopt a global marketing strategy (GMS) thereby standardizing its products and its marketing programs (Levitt 1983).

A global marketing perspective includes a strategy of standardization of product, price, promotion and placement (channel) as well as integration of advertising and global IMC. This standardization and integration can be implemented at varying degrees for the purpose of enhancing performance, maximizing value chain through configuration-coordination, achieving economies of scale, scope, comparative or

competitive advantage, and learning curve efficiencies (Zou and Cavusgil 2002; Griffith, Chandra et al. 2003).

Industrial Organization (IO) and Resource-based View (RBV) Theories—A Global Marketing Framework

The theory of global marketing and the global marketing strategy (GMS) was developed to address a gap within the literature based on the limitations of the theories of the industrial organization (IO) view of the firm and the resourced-based view (RBV). The IO as defined by Venkatraman and Prescott (1990) states that the “fit between a business’s strategy and its environment has significant implications for performance and assumes that the ultimate goal of firms is to maximize profits.” In other words, IO looked at factors external to the firm. While, Collis (1991) describes firms having a RBV as analyzing and being concerned with internal organizational factors such as assets—including intangible assets—a firm accumulates over time. In the RBV, these internal factors drive strategy and performance.

The GMS work of Zou and Cavusgil (2002) integrated the competing and even contradictory internal and external perspectives to provide a complete explanation of global strategy and performance. Zou and Cavusgil (2002) leveraged these two approaches by developing a multidimensional conceptualization of global marketing. The unified conceptual framework they developed provides a more robust means to explain global strategy and performance and broadens the use of the term global strategy to not only include standardization, configuration and coordination, or integration but to also include managing the degree to which all of the marketing tools and resources can be controlled by a firm’s management. Since they found that GMS

positively influenced a firm's performance in the global market, it would likely enable the firm to gain competitive advantages as well (Zou and Cavusgil 2002). Zou and Cavusgil (2002) also found that a firm's GMS is driven by their global orientation and international experience. The importance of experience is also consistent with the entry mode decision-making process companies' use because of its market or resources (Brouthers and Brouthers 2000).

Okazaki et al (2006) further extended the GMS framework and found that for firms to achieve their global objectives a key component is to standardize advertising such as a uniform brand image. In their model, they looked at environmental factors comprised of customer and market similarity, advertising infrastructure, level of competition, strategic factors of global strategic orientation, perceived cost savings, cross border segmentation and global IMC.

It therefore stands to reason that the better a company understands their GMS and controls the degree of standardization, configuration-coordination and integration, and advertising infrastructure and IMC, the more likely it is they will be able to pick to what degree and mix of standardization of advertising (uniform strategy and execution) and standardization of brand image and to what degree.

Standardization of Advertising Debate

Just as the debate about globalization and standardization continues, so the debate about the standardization of advertising and standardization or localization of advertising campaigns (Kanso and Nelson 2006) continues. Knowledge of local markets versus centralized decisions play specific roles in the standardizing decisions—with knowledge of local market conditions leading to more standardized approaches

(Solberg 2002). Alternatively, (Kanso and Nelson 2002) note that a strategy of standardization of advertising to be ill advised based on studying the attitudes of executives of American and non-American subsidiaries in two European countries thus not all findings support standardization. When local manager's perspective were studied, Jeong, Tharp et al (2002) found their knowledge and understanding of the international advertising policy of the firm lacking. This lack of knowledge and understanding plays a negative role in the standardization of advertising. Additionally, Karande, Almurshidee et al (2006) found that standardization is not appropriate for "product-related ad content when social-economic differences exist among culturally similar markets." While Zou and Cavusgil (2002) and Okasaki et al (2006) found that standardization is key, empirical support for standardization of advertising continue to be mixed seemingly because international business is still in transition. The calls for research in these areas as well as the global marketing debate continues (Kanso and Nelson 2006).

Standardization of Advertising

As part of GMS, Okazaki et al (2006) define standardization of advertising as a desire to create and communicate a higher level of a homogeneous image of the firm and its brand in multiple markets so that a higher level of uniform brand image across markets would enhance global brand equity. This definition will be used for this study. A global marketing perspective also includes a strategy of standardization of product, price, promotion and placement (channel) as well as integration of advertising and global IMC. This standardization and integration can be implemented at varying degrees for the purpose of enhancing firm performance, maximizing value chain

through configuration-coordination, achieving economies of scale, scope, comparative or competitive advantage, and learning curve efficiencies (Zou and Cavusgil 2002; Griffith, Chandra et al. 2003). Gabrielsson, Gabrielsson et al (2008) found that when firms globalize to other continents they increase standardization of their advertising campaigns across continents. Duncan and Ramaprasad (1995) found that MNCs use standardization most often in strategy, less often in execution and least often in language. Conversely, Backhaus, Mahlfeld et al (2001) suggest that the most significant influence on perceived standardization of advertising is the visual aspect. Taylor and Okazaki (2006) showed that the level of standardization is a combination of uniform strategy and execution ultimately leading to the ability to achieve advertising effectiveness and financial and strategic performance (with strategy used more frequently than execution).

It stands to reason that the better marketing executives *believe* they understand and use uniform strategy, uniform execution and a standard brand image in the markets in which they operate, the more likely it is they will improve the firm's financial performance. As such, uniform strategy and uniform execution (which combine to create standardized advertising) and brand image will be used to identify whether perceptions of uniform strategy or uniform execution are more related to performance as well as how and to what level brand image mediates these relationships. The following sections describe the model presented in Figure 1 below, and explain the constructs and the relationships among the constructs.

Model

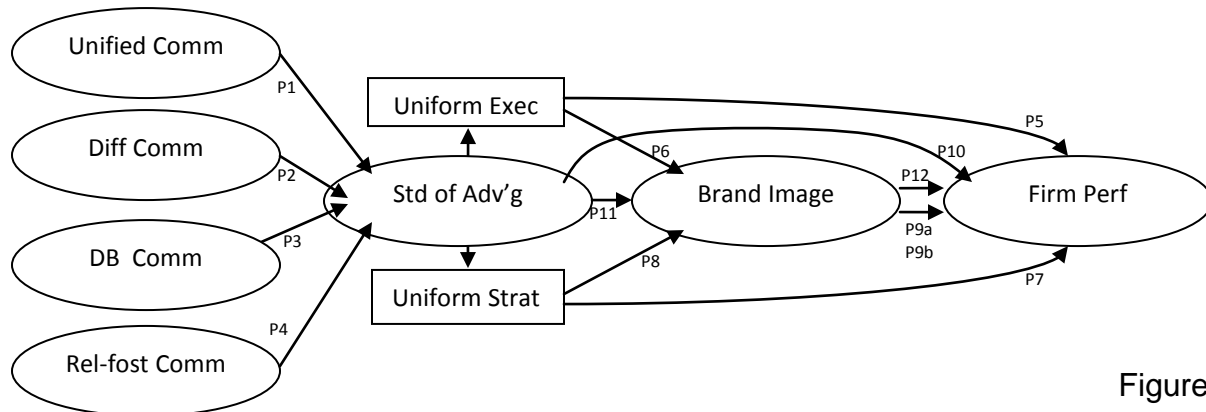


Figure 1

Independent Variables Global IMC

Schultz, Tannenbaum and Lauterborn (1992) first conceptualized the IMC construct. In their book, IMC was presented as a consistency of message across strategically timed media. It included direct marketing, public relations, personal selling as well as traditional advertising constructs all leading to a measurable consumer action. Since that time, the definition has been revised a number of times. While IMC's specific applications and effectiveness continue to be debated, the trend is that IMC is not going to go away and will continue to be a driving force in both academia and management decision-making (Gould 2000).

Kitchen, Kim et al (2008) recently asked the question about why there are still practitioner applications being studied and found that the continued application and growth of the IMC concept is the primary cause. There is a body of literature that relates brand orientation, market orientation and IMC to outcomes such as brand

performance and marketing communications performance (Low 2000; Reid, Luxton et al. 2005; Lee and Park 2007). Current IMC research has begun to study the synergy and effectiveness of and between multimedia communications, specifically, the synergy among the media budget, media mix, and advertising carryover (Naik and Raman 2003). Also Dewhirst and Davis (2005) demonstrated that greater brand equity and shareholder value were achieved using three IMC practices (specifically brand communication, cross-functional planning and monitoring, and data-driven targeting and communication). Studies looking at IMC adoption have reported results ranging from 66% to 75 % and as high as 95% of the responding organizations reporting implementing IMC (Carlson, Grove et al. 2003).

Gould (2004) suggested that IMC be defined as “1) a set of practices and discourses that is employed by marketing communications practitioners, studied by academics researchers, and taught by many of the latter to their students and 2) as a subject for theoretical analysis that may assess among other things conceptual issues, how IMC functions, and issues of effectiveness. “ To better assess scope and depth of IMC and more accurately measure IMC on the marketing communications performance, Lee and Park (2007) developed and empirically tested a four-dimensional, 18-item scale. This scale included three dimensions measuring the existing IMC concepts (unified communications for consistent message and image, differentiated communications to multiple customer groups, database-centered communications for tangible results) and added a new dimension (relationship-fostering communications with existing customers). Since this scale provides more depth and accuracy, it will be used as part of this study to replace the IMC measure used by Okazaki et al (2006).

Thus, expanding Okazaki et al (2006) who found a positive relationship between a one-dimensional measure of IMC and standardization of advertising the following four hypotheses are derived.

Dimensions of IMC

Unified communications for consistent message and image is based on the work of Nowak and Phelps (1994), in which they found that the marketing communication tools used for creating an image need to be integrated and consistent message integration and coordination in marketing communications creating “one-voice” and a unified identity of a brand. Thus, Proposition one.

P1: Firms that emphasize unified communications for consistent message and image will have a higher degree of Standardization of Advertising

Lee and Park (2007) recognize that at any given point in time of the buying process, people are in various stages. Unlike the coordinated perspective of Nowak and Phelps’s (1994) one voice view, differentiated communications to multiple customer groups recognizes these differences as well as the need for a multiple brand positioning that targets these customers in the market. As such, the marketing communication focus would be less standardized with emphasis placed on “creating awareness, fostering favorable attitudes, or establishing conviction” (Lee and Park 2007). Therefore,

P2: Firms that emphasize differentiated communications to multiple customer groups will have a lower degree of Standardization of Advertising

The dimension of database-centered communications focuses on the use of intensive customer information using technology-driven communications to get

behavioral responses from customers that result in tangible firm performance outcomes. The more that is known about these customers using databases, the more able communications can be standardized based on similarities and differences. This proposition is:

P3: Firms that emphasize database-centered communications will have a higher degree of Standardization of Advertising

The last IMC dimension is relationship-fostering communication that is rooted in customer relationship management. Reicheld (1996) showed that “retaining existing customers was five times more cost-effective than acquiring and developing relationships with new customers.” Because it is so expensive to get new customers, it is critically important to know one’s customers as well as use and standardize customer relationship communications. Hence,

P4: Firms that emphasize relationship-fostering communications with existing customers will have a higher degree of Standardization of Advertising

Standardization of Advertising—Uniform Execution

Knowledge of local markets versus centralized decisions plays specific roles in the standardizing decisions—with knowledge of local market conditions leading to uniform execution of a more standardized approach (Solberg 2002). However, Karande, Almurshidee et al (2006) found that standardization execution is not appropriate for “product-related ad content when social-economic differences exist among culturally similar markets.” In a survey of advertising agency executives, Duncan and Ramaprasad (1995) found that agency clients were increasingly seeking uniform executions in their advertising execution. This industry trend indicates a perceived benefit to firm performance.

Standardization of Advertising—Uniform Strategy

Recent studies have addressed advertising standardization at the uniform strategy level. Griffith, Chandra et al (2003) looked at standardizing packaging and advertising message and received mixed results. Local managers' perspectives have been studied with regard to their lack of knowledge and understanding of the international advertising strategy of the firm and the negative role that can have in the standardization of advertising (Jeong, Tharp et al. 2002). Okazaki et al (2006) view uniform strategy and uniform execution as a combined standardization of advertising construct that are positively related to firm performance. As such, the transformed mediating variable in this study will use this definition of standardization of advertising.

The propositions are:

P5: Uniform execution will positively impact firm performance

P6: Uniform execution will positively impact brand image.

P7: Uniform strategy will positively impact firm performance

P8: Uniform strategy will positively impact brand image.

Brand Image

Traditional advertising models, in effect, move consumers through brand awareness to brand image and brand attitude which both lead to purchase intentions or purchase (Smith and Swinyard 1982). Within the standardization of advertising literature there has been little research tying brand image (itself an advertising outcome variable Roth 1995a 1995b) to performance. One of the few to do so is Roth (1992) who demonstrated that brand image is positively related performance measures such as sales volume, market share and profit margin in a global context. In another article in

the same year, Samiee and Roth (1992) found that across a variety of global industries, performance did not differ between firms using global standardization and firms using customization as marketing strategies. Current research has shown that regardless of the level to which markets are or are perceived to converge, firms want to create a uniform brand image as a function of their goal of building brand equity (Okazaki 2007). Additionally, they suggest that firms that seek to create a uniform brand image and appeal to cross-market segments are more likely to standardize their overall advertising programs. This leads to the following research propositions:

P9a: Brand image will mediate the effect uniform strategy has on performance.

P9b Brand image will mediate the effect uniform execution has on performance.

Dependent Variable—Firm Performance

Performance measurements have been operationalized several ways within extant brand image and standardization of advertising literature. In a study about services industry advertising and consumer reactions to performance promotions/announcements by Mathur, Mathur et al (1998), three measures of financial performance were used – growth in earnings per share, net profit margin, and return on assets. Onkvisit and Shaw (1999) suggest that firms use sales volume as a criterion for effectiveness however, Kanso and Nelson (2006) call for research to link a firm's performance in terms sales and corporate image to measures of standardization of advertising's effectiveness.

Solberg (2002) notes that perception is the best way to capture performance of a firm's export success because it uses the respondent's opinions of perceived degree of economic success (such as market expansion, competitive response and market

penetration). Okazaki et al. (2006) define a firm's financial performance as a "bottom-line measure that refers to the firm's success in increasing its sales and profitability" and note that standardization of advertising improves firm performance. In that study, standardization was operationalized as the combination of uniform strategy and uniform execution. This study recognizes that there are multiple determinants of performance (Okazaki et al, 2006) and predicts that managers who perceive they have higher levels of standardization in execution and strategy and brand image will have enhanced measures of performance. Therefore

P10: Standardization of advertising is positively related to firm performance

P11: Standardization of advertising is positively related to brand image

P12: Brand image is positively related to firm performance

Conclusion

This paper has developed a model to test the impact of IMC and standardization on firm performance. The model is developed from the existing literature and combines the global marketing strategy with integrated marketing communications. It is a valuable guide for future researchers to examine these inter-relationships and combine branding, marketing communications and global business.

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REVERSE LOGISTICS PLANNING IN A SUPPLY CHAIN NETWORK BUSINESS MODEL

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ABSTRACT

This paper presents a mixed integer programming (MIP) business planning model for a supply chain network (SCN) that includes a central node, a set of manufacturers on the supply side and a set of retailers on the marketing side. The model plans for the manufacture and marketing of products at three quality levels that include recovered product quality. The proposed SCN addresses the collection of returned products like warranty items, defective items and end-of-life-products from consumers via retailers using a contractual agreement. The model decides optimum proportion of the product to be manufactured at different quality levels for improving supply chain's overall performance. In addition, the model includes a quality-oriented approach for allocating products to the manufacturers, distributing products to the customers and creating safety stock at the distribution centers as a way of addressing product demand and transportation lead time variations. A numerical example illustrates the applicability of the model.

Keywords: supply chain network model; recovered product quality; product at different quality levels; collecting returned items; central planning node; uncertainty in demand and transportation lead time.

1. INTRODUCTION

In the current business trends most supply chains (SCs) have either included the reverse logistics (RL) in their business planning, or are quickly working towards that goal. The importance of RL to SC managers is the result of several factors, including: the imposition of governmental regulations[13]; the movement towards achieving a competitive place in the market and creating a sustainable business strategy [7] and obtaining the opportunity for enhanced business that maintains customer support as well as makes profit [10]. In addition to the business advantages and regulatory requirements, RL is also favored by most current-day customers [12] [17]. SCs that wish to incorporate RL as a way of obtaining business advantages or comply with regulatory requirements should critically consider two crucial factors: RL is a complex business process [10], and recovered products will always be in competition with new products [8]. Over and above these factors, SCs must also take into account that the RL process involves customers, suppliers, manufacturers, retailers, transportation and distribution for its planning and effective implementation. Considering the involvement of RL in each phase of the business process, it is only logical that RL should be integrated in the overall SC planning to balance operations, provide satisfaction to the customer and obtain improved SC performance.

The critical challenges in RL planning are the collection of returned products from customers or reverse channeling [9] and how best to handle the recovery [15]. Several studies recommend the involvement of third-party logistics for collection and recovery [9]. Collection of end-of-life products (ELP), returned or defective items should be driven by reasonable profit if third-party logistics were to be involved. Most of the returned products do not have any value in terms of functionality, but rather for the materials only if they can be reprocessed [14]. For products with short life cycles, like copiers, computers, cell phones and

such others, several components may be recovered or some functional value may be obtained if the condition of the product permits, but conditions are often unknown. In addition, in any product group business, the product mix for returned items remains completely unknown. Another question that must be addressed, with the exception of warranty items or replacement options for defective items, is how to create the motivation consumers need to return products.

Logical plans should be developed for setting collection options that will not require consumers to locate and visit a collection center just to drop off ELPs, warranty or defective items. Based on these collection-related factors, ideal planning would involve retailers or selling outlets in the collection of returnables using appropriate promotional steps that would include reasonable incentives for motivating consumers to return the items and provide information as well as options for facilitating the returns. The goal would be for the consumer or user to know from the moment of ownership that the product may be returned at any outlet or retail points by calling the company representatives or sending the product to the retail centers. This provision of using retail outlets creating a collaborative network of collection centers will make the returning process easy, cost effective and customer friendly by establishing the fact that the consumers do not need to go to different places to return different items. A retailer or selling outlet usually markets several products from several suppliers, so encouraging a collaborative relationship with suppliers might make the collection of returned items a viable business component for retailers and outlets.

The next factor to consider is the recovery process, which may be handled by the original manufacturer of the product, or by third-party logistics. Since it is very difficult to pre-determine the quantity and quality of returned products, it may not be feasible for the manufacturer to open a recovery facility for their returned or reverse channeled products. As such, based on economic feasibility, a recovery service provider (RSP) organization or a network of RSPs appears to be the suitable option for the recovery process. While the economic feasibility of recovery is a crucial factor, one also must consider that product recovery has not yet been established as a standardized system. The recovery process for different product types [17] would involve different expertise, making the manufacturer of the product the most competent guide for the RSPs in their recovery process. In this research, the proposed SCN considers the collection of returned products through retailers, and plans for the recovery of returned products via a network of RSPs guided by the manufacturer, who will also control the recovery process through an agreement with the SCN. Under this agreement the manufacturer will be responsible for recovering the usable inputs from the returned products sent by retailers after collecting them from consumers.

The SCN suggested in this research follows a quality system-aligned business process that places it in a partnering contract with the manufacturers and retailers involved in their RL-integrated business operations. The distinguishing contribution of this research is the introduction of an innovative SCN model that integrates multi-quality level and multiple product based RL that includes the involvement of a set of manufacturers and retailers to decide product proportion at different quality levels to maximize the overall business performance. The next contribution is the introduction of a viable planning approach for involving retailers in the collection of returned items and engaging manufacturers in the recovery of returned items through a team-based approach with RSPs. The paper also includes a quality oriented approach for partnering with the network of manufacturers and creating safety stocks at DCs to handle demand and transportation lead time variations.

This paper is organized in the following way: the next section reviews the relevant literature; Section 3 includes the problem statement, formulates the SCN model and describes the model equations; Section 4 presents a numerical example and illustrates the applicability of the model and Section 5 concludes and discusses.

2. LITERATURE REVIEW

RL consideration in business process planning has been gaining importance across the entire global market. In recent years, RL has received significant attention from academicians and SC managers [9]

[13] [15]. This section studies recent relevant literature that addresses planning for the collection of returned items, recovery of usable items from returned products, RL-based SCN planning and consideration of product proportion at different quality levels.

Aras and Aksen [2] proposed a modeling approach to determine optimal location distances for collection centers and establish paying incentives for product returns. The authors categorized returned products at different quality levels and planned consumer incentives around said levels. In a similar study, Tagaras and Zikopoulos[16] addressed the issue of optimal locations for multiple returned products collection sites. The authors also investigated the effect of sorting the disassembled items at the collection centers and central locations based on their remanufacturing suitability. Chouinard *et al.* [3] also studied the quality level of returned products using a stochastic modeling approach. The authors divided product quality level into five states to decide recovery processing alternatives: $s=0$, unknown; $s=1$, new; $s=2$, good condition; $s=3$, deteriorated and $s=4$, unusable. Thierry *et al.* (1995) defined five product recovery systems: re-manufacturing, repairing, refurbishing, cannibalization and recycling. That study included a comprehensive discussion of the product design approach for recovery, the importance of reducing disposal waste and preparing customers for green products as well as addressing environmental legislation issues for recovery systems.

DeCroix [6] investigated the impact that product recovery and the remanufacturing of used products might have on an SC's inventory system. DeCroix studied the impact of introducing remanufactured products (RP) both upstream and downstream within the process, and reported that RP introduction upstream would provide optimal policy without any negative impact, while RPs flowing downstream could impact the echelon inventory at the upstream and should be analyzed to determine similar policy structure. Schultmann *et al.* [14] modeled RL problems for automobile vehicle industries with a focus on specific cases of end-of-life vehicle (ELV) treatment in German closed-loop SCs. Their study evaluated network design concepts for separating and reprocessing plastic ELV components. Schultmann *et al.* recommended the establishment of a product recovery network, taking a collaborative approach to minimize costs for instances in which product recovery must be free of charge to fulfill legal requirements. Cruz-Rivera and Ertel [4] studied the RL problem for ELVs in Mexico following an un-capacitated facility location problem to determine cost and location centers that would consider 100%, 90% and 75% collection coverage.

Alshamrani *et al.* [1] designed an RL for the return of materials generated by deliveries on a delivery route. The research modeled the delivery of containers used for blood distribution by the American Red Cross. The authors developed a model for deciding optimum routes with number of pickups and pick up volumes when the volumes requirements for the stop points along a route were probabilistically known. Finally, the authors developed a heuristic procedure with several rules for solving the model.

Based on the survey and analysis of the automobile aftermarket industry, Daugherty *et al.*[5] recommended an Internet-based, information technology (IT)-focused resource commitment for improving RL-based SC performance. To achieve the desired performance the IT was planned to provide detailed information to the network-based customers about collection, tracking and the handling of returns so that e-business customers would build the required confidence in business transactions. Lieckens and Vandale [11] proposed a queuing-based MIP model for designing a single product-based RL network to address stochastic lead /cycle time and inventory costs.

The relevant literature is quite diverse when addressing RL problems of collection, recovery and closed-loop SC design issues, but it is also apparent that there is no comprehensive and practicable approach that may be pursued by SC managers that consider their overall product portfolio to be at different quality levels, and wish to formulate their RL problems to obtain optimal solutions for the collection and recovery of returned items. There is no research that considers using the retailer for the collection of returned items, and none of the relevant research considered the practical approach of involving RSPs through manufacturers to obtain the desired recovery quality within an optimum cost. It is easy to establish that using retailers for the collection of returned items would provide a customer friendly, effective and efficient solution to the limitations SCs are facing with the existing practices. Recovery is a complex process, and it may not be possible to obtain optimum recovery of acceptable quality returned

items through just one or two third-party RSPs if they are not in a team managed by the product manufacturer. This paper introduces an MIP-based approach for planning returned product collection through retailers and obtaining recovered products through the manufacturer as a way of improving overall SC performance.

3. THE SUPPLY CHAIN NETWORK MODEL

This section describes the indices and parameters, the problem statement and the formulation of an SCN model that addresses both overall business and RL planning for optimum business performance.

3.1 Indices and Parameters

Indices

P : Set of products, $p \in P$, returned items/products are also denoted as p (described as: equivalent product, or EQPR) ;

i : set of raw materials/components/inputs, $i \in I$,

M : set or pool of manufacturers, $m \in M$,

S : set of scenarios applicable for return of products/items by the customers, $s \in S$;

C : set of customers/retailers, $c \in C$, quality levels Q , $q \in Q$;

W : set of warehouse /distribution centers (DCs) ;

Parameters

D_{pc} : random product demand, $N(\mu d_{pc}, \sigma_{pc}^2)$ where: μd_{pc} is the mean product demand and σ_{pc}^2 is the variance

C_{pqm} : production cost for product p at quality q by manufacturer m

CC_{pc} : contractual cost of collecting returned product p by retailer c

CN_{im} : cost of new input i from manufacturer m

CR_{im} : cost of recovery for input i from manufacturer m

CPR_{im} : recovery capacity of RSPs in which manufacturer m is in a team for input i

CPN_{im} : capacity of manufacturer m for supplying/manufacturing new input i

CT_{pmw} : unit transportation cost for product p from manufacturer m to DC w

ELT_{mw} : estimated mean lead time between manufacturers to DCs using scenario based analysis

LT_{mw}^s : lead time between manufacturer m and DC w at scenario s

PL_{mw}^s : probability of LT value at scenario s

MC_{pqm} : manufacturing capacity of manufacturer m for product p at quality q

WC_{pqw} : capacity of DC w for warehousing product p at quality q

MT_{pmc} : unit transportation cost for product p from manufacturer m to retailer c

FW_w : fixed cost for opening DC w

MCT_m : special arrangement cost for direct supply to retailers c from manufacturer m

QM_{pm} : quality monitoring cost for manufacturer m that supplies product p

FM_{pm} : fixed setup cost for manufacturer m for producing product p at different quality

RF_{im} : fixed set up cost for managing recovery of input i from returnable by manufacturer m

NF_{im} : fixed cost for obtaining new input i from manufacturer m

FC_c : fixed contractual cost for retailer c for collecting returnable

QC_p : quality inspection cost for product p

EI_p : percentage to be inspected for product p
 v_{pqc} : price/unit that customer c is willing to pay for product p at quality level q
 u_{pm} : 0/1 parameter, 1, if manufacturer m is quality affiliated for product p , 0 otherwise
 H_{pm} : 0/1 parameter, 1, if manufacturer m is high quality affiliated for product p , 0 otherwise
 PPN_{pqi} : usage of new input i for product p at quality q
 PPR_{pqi} : usage of recovered input i for product p at quality q
 PR_{pi} : recovered equivalent component i from product p
 R_{pcm} : returned product p (EQPR) collected by retailer c and sent to manufacturer m
 DF_{pc}^s : returned product (fraction of demand) collected by retailer c at scenario s
 PD_{pc}^s : probability of the scenario s collecting DF fraction of product p by retailer c
 U_{im} : usable recovered input i through the RSPs managed by manufacturer m
 Z_{im} : new input used by manufacturer m ,
 y_{pqwc} : product p of quality q distributed from DC w to customer c
 x_{pqm} : product p of quality q procured from manufacturer m
 $xq1_{pqm}$: product manufactured by manufacturer m at $q=q1$ quality level
 $xq2_{pqm}$: product manufactured by manufacturer m at $q=q2$ quality level
 $xq3_{pqm}$: product manufactured by manufacturer m at $q=q3$ quality level
 $x2_{pqmw}$: product p of quality q supplied by manufacturer m to DC w
 $x1_{pqmc}$: product p of quality q supplied by manufacturer m to customer c
 δ_w : 1, if DC w is open, 0 otherwise
 ρ_{mc} : 1, if product is directly sent from manufacturer m to retailer c , 0 otherwise
 a_{pm} : 1, if manufacturer m is set up for producing product p , 0 otherwise
 b_{pc} : 1, if retailer c is in contract for collecting input p , 0 otherwise
 e_{wc} : 1, if DC w is allocated to retailer c , 0 otherwise
 n_{im} : 1, if manufacturer m is allocated for supplying new input i , 0 otherwise
 r_{im} : 1, if manufacturer m is allocated for recovery of input i , 0 otherwise
 BN : big numbers
 BM : big numbers

3.2 Problem Statement

The SCN design problem addressed in the research includes a set of manufacturers M producing set of products P at quality levels $Q = \{q1, q2, q3\}$, and a set of DCs W distributing the products to customer C . For each product p , $p \in P$ the SCN markets recovered/reconditioned/remanufactured products at quality level $q3 \in Q$ in addition to products at other quality levels $\{q1, q2\} \in Q$. The $q2$ quality level product uses a predefined mixture of new and recovered components while $q1$ uses only new components. The SCN procures products from manufacturer m —affiliated as an acceptable quality level manufacturer (AQM) or a high quality level manufacturer (HQM) based on the QA system followed by the SCN. The AQMs and HQMs are first affiliated based on a QA system as QAMs, and then categorized as AQMs and HQMs using a performance-based rating. The HQM m is in a partnership business contract with the SCN, and AQM m is in a spot selling contract with the SCN. The HQM m directly supplies the product to customer c without any shipment inspection. Products procured from AQM m are subject to inspection and warehoused in DC w after procurement, then distributed to customers subsequently.

The SCN has a contractual agreement to pay CC_{pc} to retailer c for collecting returned product p from the consumers using suitable incentive plans and promotions. The returned product may be a component, assembly, sub-assembly, end-of-life or defective product converted to an equivalent product p as a part of the contract between the retailer and the SCN. The returnable quantity R_{pcm} for EQPR (equivalent product) p collected by retailer c is uncertain, and estimated using a scenario-based analysis that considers

data/information from previous experience or instances of similar product returns by the consumer to the retailers. The returnable R_{pcm} is then sent to AQM m and HQM m to recover inputs i by engaging a network of RSPs. The recovered inputs i are used subsequently in producing saleable recovered/secondhand quality products at quality levels $q1$ and $q2$. As mentioned before, each collected returnable is converted to EQPR according to the agreed criteria between the retailer and SCN. The SCN supports retailers in the conversion of returnables to EQPR by involving AQMs/HQMs that are allocated for production using these recovered inputs from the EQPR. Each collected product is dismantled, sorted and transformed into EQPR for appropriate accounting. As such, it is assumed that the losses arising from unusable or partially recoverable returnable products are taken into account during the transformation to EQPR. It is also assumed that each EQPR is finally converted into its components $i \in I$ during the subsequent manufacturing process. The manufacturers charge fixed cost RF_{im} for recovering input I and per unit recovery cost CR_{im} for recovered inputs U_{im} , as well as the production cost for transforming inputs to outputs C_{pqm} for the SCN's secondhand qualities $q3$ and $q2$. Using the same analogy, the SCN also pays fixed cost NF_{im} and cost of buying CN_{im} for the new input quantity Z_{im} , and production cost C_{pqm} to the AQMs/HQMs for producing $q1$ and $q2$ quality level products.

The SCN faces random product demand D_{pc} for product p from customer c that follows a normal distribution $N(\mu d_{pc}, \sigma_{pc}^2)$. Based on the past history, a decision about the percentage of product to be produced and marketed at different quality levels is crucial for their overall business performance. One of the main objectives of this research is to propose past history-based range limits for deciding what percentage of product the SCN should market at different quality levels (recovered quality $q3$, quality level $q2$ and quality level $q1$), as well as to maximize their overall profit based on other business parameters and constraints. Additional objectives include the assignment of retailers for collecting returnables, the allocation of production and recovery to manufacturing networks selected and monitored in a QA system, the transportation of products to customers and warehouses, maintaining safety stocks at the DCs to provide the desired customer service level and addressing demand variation and transportation lead time uncertainty.

3.3. Formulation of the Model

Objective Function: maximize *Profit* (1)

$$Profit = REV - (PDCST + INCST + TDCST + ICST + QACST) \quad (1.a)$$

where:

REV: revenue earned by satisfying market demand through retailers; *PDCST*: product procurement cost; *INCST*: cost of recovered items; *TDCST*: transportation and distribution cost; *ICST*: inventory cost; *QACST*: quality assurance cost.

$$REV = \sum_{p \in P} \sum_{q \in Q} \sum_{c \in C} v_{pqc} \left(\sum_{w \in W} y_{pqwc} + \sum_{m \in M} x_{pqmc} \right) \quad (1.b)$$

$$PDCST = \sum_{p \in P} \sum_{q \in Q} \sum_{m \in M} C_{pqm} x_{pqm} + \sum_{p \in P} \sum_{m \in M} a_{pm} FM_{pm} \quad (1.c)$$

$$INCST = \sum_{p \in P} \left(\sum_{c \in C} CC_{pc} \sum_{m \in M} R_{pcm} \right) + \sum_{c \in C} FR_c \sum_{p \in P} b_{pc} + \sum_{i \in I} \sum_{m \in M} Z_{im} CN_{im} + \sum_{i \in I} \sum_{m \in M} U_{im} CR_{im} \quad (1.d)$$

$$+ \sum_{m \in M} \sum_{i \in I} RF_{im} r_{im} + \sum_{m \in M} \sum_{i \in I} NF_{im} n_{im}$$

$$TDCST = \sum_{m \in M} \sum_{w \in W} \sum_{p \in P} CT_{pmw} \sum_{q \in Q} x2_{pqmw} + \sum_{m \in M} \sum_{w \in W} \sum_{p \in P} MT_{pmc} \sum_{q \in Q} x1_{pqmc} + \quad (1.e)$$

$$\sum_{w \in W} FW_w \delta_w + \sum_{m \in M} MCT_m \sum_{c \in C} \rho_{mc} + \sum_{p \in P} \sum_{w \in W} \sum_{c \in C} CD_{pwc} \sum_{q \in Q} y_{pqwc}$$

$$ICST = ELT_{mw} h.SF.\sqrt{\sigma_{pc}^2} \quad (1.f)$$

$$QACST = \sum_{p \in P} \sum_{m \in M} QM_{pm} u_{pm} + \sum_{p \in P} QC_p EI_p \sum_{q \in Q} \sum_{m \in M} \sum_{w \in W} x2_{pqmw} \quad (1.g)$$

s.t.

$$\sum_{q \in Q} x1_{pqmc} + \sum_{q \in Q} y_{pqwc} = \left\{ \int_0^{\infty} D_{pc} \varphi(D_{pc}) dD_{pc} + K\phi^{-1}(1-\alpha)\sqrt{\sigma_{pc}^2} \right\} \forall p, m, w, c \quad (2)$$

$$\phi(SF) \geq \alpha \quad (3)$$

The following equation may be obtained using the two equations above:

$$\sum_{q \in Q} \sum_{m \in M} x1_{pqmc} + \sum_{q \in Q} \sum_{w \in W} y_{pqwc} = \{ \mu d_{pc} + K.SF\sqrt{\sigma_{pc}^2} \} \quad \forall p, c \quad (4)$$

In the above equations D_{pc} is the stochastic demand quantity satisfying a normal distribution, $\mu d_{pc}, \sigma_{pc}^2$, and $\varphi(D_{pc})$ are, respectively, the mean, variance and probability density function of D_{pc} . $(1-\alpha)$ is the service fraction for an assumed non-stock out situation and may be taken from 0.95 to 0.99. K is a multiplication factor to increase SF for considering the effect of desired lead time to be estimated using the scenario-based analysis to follow.

$$\sum_{q \in Q} x1_{pqmc} \leq BN.\rho_{mc} \quad \forall p, m, c \quad (5)$$

$$\sum_{q \in Q} y_{pqwc} \leq BM.e_{wc} \quad \forall p, w, c \quad (6)$$

$$\sum_{m \in M} x2_{pqmw} = \sum_{c \in C} y_{pqwc} \quad \forall p, q, w \quad (7)$$

$$\sum_{c \in C} x1_{pqmc} + \sum_{w \in W} x2_{pqmw} = x_{pqm} \quad \forall p, q, m \quad (8)$$

$$xq1_{pqm} + xq2_{pqm} + xq3_{pqm} = x_{pqm} \quad \forall p, q, m, \text{ q is the index for quality level} \quad (9)$$

$$xq1_{pqm} = x_{pqm} \quad \forall p, q = q1, m \quad (10)$$

$$xq2_{pqm} = x_{pqm} \quad \forall p, q = q2, m \quad (11)$$

$$xq3_{pqm} = x_{pqm} \quad \forall p, q = q3, m \quad (12)$$

$$\beta1. \sum_{c \in C} \mu d_{pc} \leq \sum_{m \in M} xq3_{pqm} \leq \beta2. \sum_{c \in C} \mu d_{pc} \quad \forall p, q = q3, \beta1, \beta2: \text{ predefined fractions} \quad (13)$$

$$x_{pqm} \leq MC_{pqm} a_{pm} \quad \forall p, q, m \quad (14)$$

$$a_{pm} \leq u_{pm} \quad \forall p, m \quad (15)$$

$$\sum_{m \in M} x2_{pqmw} \leq WC_{pqw} \delta_w \quad \forall p, q, w \quad (16)$$

$$\rho_{mc} \leq H_{pm} \quad \forall p, m, c \quad (17)$$

$$e_{wc} \leq \delta_w \quad \forall w, c \quad (18)$$

$$\sum_{m=1}^M R_{pcm} = b_{pc} \sum_{s \in S} PD_{pc}^s DF_{pc}^s \mu d_{pc} \quad \forall p, c \quad (19)$$

$$\sum_{p \in P} \sum_{c \in C} R_{pcm} PR_{pi} = U_{im} \quad \forall i, m \quad (20)$$

$$U_{im} \leq r_{im} CPR_{im} \quad \forall i, m \quad (21)$$

$$r_{pm} \leq u_{im} \quad \forall p, i, m \quad (22)$$

$$Z_{im} \leq n_{im} CPN_{im} \quad \forall i, m \quad (23)$$

$$n_{im} \leq u_{im} \quad \forall p, i, m \quad (24)$$

$$\sum_{i \in I} (U_{im} PPR_{pqi} + Z_{im} PPN_{pqi}) = x_{pqm} \quad \forall p, q, m \quad (25)$$

$$ELT_{mw} = \sum_{s \in S} LT_{mw}^s PL_{mw}^s \quad \forall m, w \quad (26)$$

$$a_{pm}, \rho_{mc}, d_w, e_{wc}, b_{pc}, n_{im}, r_{im} \in \{0,1\}, \forall p \in P, m \in M, c \in C, w \in W, i \in I \quad (27)$$

The objective function maximizes the profit defined in Equation (1.a) by considering revenue earned and SC costs spent to earn that revenue. The revenue in Equation (1.b) is earned by supplying products from DCs and directly from the HQM or partner-manufacturers (PMF) to the customers. The product procurement cost *PDCST* in Equation (1.c) is computed by considering the production cost and fixed cost needed to make a contract with the manufacturer. *INCST* in Equation (1.d) includes computation of total input costs for: collecting returned products through retailers, fixed contractual arrangement for such collection, recovery of usable inputs obtained from returned items, cost of buying new inputs and the fixed cost for buying such inputs from quality affiliated manufacturers (QAMs). *TDCST* in Equation (1.e) computes the total cost of transporting the product from manufacturer to DCs, distributing products from DCs to customers and transporting portions of the product directly from PMFs to customers. *ICST* in

Equation (1.f) estimates the safety stock keeping cost for addressing demand uncertainty and transportation lead time uncertainty. The safety stock provision for a desired non-stock-out service level is planned considering that demand will vary following a normal distribution and estimating transportation lead time for manufacturer-DC combinations using a scenario-based analysis. $QACST$ in Equation (1.g) computes the total quality assurance cost of the quality monitoring cost for manufacturers supplying products and inspection costs for products procured under spot buying contracts with the AQMs.

Constraint (4) determines which products will be sent to the market to satisfy customer requirements based on Constraints (2) and (3), considering that the demand will vary following a normal distribution and a desired non-stock-out customer service level. Constraint (5) identifies the PMFs allocated to the customers while Constraint (6) allocates the DCs to the customers for supplying products. Constraint (7) balances the inflow of products to DCs from the manufacturer, and the outflow from DCs to customers. Equation (8) computes the total production quantity procured from the manufacturers based on the quantity transported directly to the customers and to the DCs. Equation(9) balances the total production quantity for the manufacturers by considering three product quality levels. Equations (10), (11) and (12) determine the production quantities produced at three quality levels. Constraint (13) limits the quantity of recovered-quality product within a pre-decided range. Constraint (14) describes the capacity limitations of the manufacturers for production. Constraint (15) ensures the procurement of product from quality affiliated manufacturers (QAMs). Constraint (16) limits the transported product quantity to a DC within its capacity. According to Constraint (17) a manufacturer is allocated to directly supply a customer only when they are a partner-type, high quality supplier (PMF). Constraint (18) ensures the allocation of DC to a customer only when the DC is open. Constraint (19) estimates the equivalent quantity of products collected by a retailer based on a scenario-based probabilistic analysis. Constraint (20) estimates the converted input items from the collected returned products. Constraint (21) allocates the recovery of inputs to the manufacturer based on their capacity limitation. Constraint (22) allocates input recovery only to the quality affiliated manufacturers (QAMs). Constraint (23) limits the allocation of new inputs by considering manufacturers' capacity. Constraint (24) ensures the allocation of new inputs only to the QAMs. Constraint (25) computes the total product quantity obtainable from recovered and new inputs using a suitable proportion transformation factor. Constraint (26) estimates the expected lead times for the manufacturer-DC combination using a scenario analysis approach. Constraint (27) imposes integrality.

4. NUMERICAL EXAMPLE

The example problem presented in this section illustrates the applicability of the proposed model with an SCN that markets 7 products manufactured by a network and 9 QAMs (quality affiliated manufacturers) using a total of 14 input components marketed through 12 retailers. As the problem statement describes, the SCN collects products returned by consumers using a contractual agreement with the retailers. For planning purposes, the SCN estimates the average collection quantity of the returnables using the scenario-based analysis modeled in Equation (19). The example involved 8991 total variables, 585 integers and 5866 constraints and took 15 minutes to solve for the model using the commercial solver LINGO 09 in an Intel Core 2, 2.0 GB RAM, 2GHZ processor PC. Our analysis illustrates the model decision on the quantity of products at different quality levels that the SCN will be dealing with to maximize profit. The model's decision regarding the collection and recovery of returned products, including their transformation to usable inputs, and the allocation of products to manufacturers will also be illustrated. Typical input instances are described in Tables 1 through 5 to create relevance for the model decision. Table 1 presents retailers' typical product demands. The demand of product 1 from retailer 1, for example, is 3061 units per year.

Table 1: Product Demand by Retailer

Product	Demand by Retailer											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3061	3478	3281	3063	3362	3284	2917	3035	3280	3011	3102	3046
2	3033	2878	2852	2974	2750	3080	3088	2993	2891	2927	3126	2980
3	2904	2974	3244	3554	3341	3591	3578	2974	3437	3349	3249	3308
4	1713	1624	1644	1628	1648	1501	1657	1509	1583	1674	1605	1562
5	2351	2462	2350	2607	2660	2373	2643	2635	2498	2450	2378	2378
6	2958	2902	2997	2834	3018	2692	3147	2690	2784	2796	2806	2926
7	1664	1634	1616	1679	1734	1830	1563	1918	1700	1584	1656	1675

The demand data in Table 1 has been generated using normal distribution. Table 2 presents the typical probabilities for scenarios 1, 2 and 3 as well as the returnable product quantity as a fraction of the demand from the retailers in these scenarios. The probability of scenarios 1, 2 and 3 for returning product 1 to retailer 1 are 0.7, 0.2 and 0.1, respectively, while the quantity returned by the consumers as a fraction of the demand in these scenarios are 0.16, 0.19 and 0.16, respectively (Table 2).

Table 2: Typical Probability Scenarios That Include the Fraction of Demand Returned to Retailers

Product	Scenario	Probability (PS) and demand fraction (DF) in scenarios returned to retailers									
		1		2		3		4		5	
		PS	DF	PS	DF	PS	DF	PS	DF	PS	DF
1	1	0.7	0.16	0.22	0.35	0.16	0.31	0.41	0.27	0.44	0.15
	2	0.2	0.19	0.6	0.32	0.55	0.3	0.57	0.33	0.17	0.34
	3	0.1	0.16	0.18	0.16	0.29	0.29	0.02	0.19	0.39	0.18
2	1	0.64	0.24	0.61	0.33	0.36	0.35	0.34	0.22	0.16	0.21
	2	0.14	0.25	0.15	0.16	0.28	0.22	0.22	0.29	0.32	0.18
	3	0.22	0.3	0.34	0.2	0.16	0.16	0.44	0.21	0.52	0.32

Table 3 presents the quality affiliation level of each manufacturers of the network as being acceptable quality AQMs or high quality HQMs (finally converted to partners PMFs) as pre-decided by the SCN's QA system. Manufacturer 1 (in column 1) is a an HQ or PMF for products 1, 3, 4, 6 and 7, for example, as well as the AQM for products 2, 5 and 6 (Table 3).

Table 3: Quality Affiliation Level for Network of Manufacturers

Product	Category of manufacturers based on quality affiliation as decided by the SCN's QA system								
	1	2	3	4	5	6	7	8	9
1	HQ				HQ	HQ	HQ		
2		HQ			HQ		HQ		
3	HQ	HQ	HQ						HQ
4	HQ	HQ				HQ		HQ	HQ
5			HQ	HQ			HQ	HQ	
6	HQ		HQ	HQ	HQ				HQ
7	HQ	HQ			HQ		HQ		

HQ : High quality manufacturer, HQMs or partners (PMFs) , Blank cells : acceptable quality manufacturers, AQMs

Table 4 presents the typical capacity of manufacturers for supplying product 1 at quality levels 1, 2 and 3.

Table 4: Typical Capacity of Manufacturer for Supplying Products at Quality Levels

Product	Quality	Capacity of Manufacturers (Units)								
		1	2	3	4	5	6	7	8	9
1	1	4738	4810	2761	3422	5043	2081	2665	4175	3702
	2	2491	5001	4509	2684	2546	3195	5094	4569	2312
	3	1853	1954	2307	1334	1452	2387	1351	1754	2079

Table 5: Usage Rates of Inputs for Manufacturing Products

Products	Usage rate of inputs													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1	1		1	1	1								
2	1	1	1								1	1	1	1
3				1	1	1	1			1	1	1		
4										1	1	1	1	1
5	1	1	1	1	1			1	1					1
6	1	1	1	1					1	1	1			
7			1				1	1	1	1	1	1	1	1

Table 5 describes the usage rate of inputs 1 through 14 for manufacturing products 1 through 7. In addition to the inputs presented above, we assumed: the capacity/maximum limit of recovered inputs that manufacturers will be managing using the partnering or team-based approach with RSPs, in addition to the capacity of new inputs the manufacturers will be managing from their own sources; the cost of recovered and new inputs; the fixed and variable costs of production and distribution as well as the capacity of DCs and transportation lead times. Most of this data has been generated using uniform distribution based on the parameter range from the author's practical experience with similar production and recovery process management.

Table 6: Typical Model Output for EQPR Collected by Retailers and Sent to Manufacturer

Product (EQPR)	Retailers	Quantity to Manufacturer1	Product	Retailers	Quantity to Manufacturer1
1	4	927	5	1	308
	10	769		4	547
	12	32		9	541
	Total	1728		Total	1396
2	4	154	6	11	685
	7	89		12	469
	11	780		Total	1154
	Total	1023			
3		0	7	3	307
				5	251
	Total	0		12	220
				Total	778
4	6	127			
	8	68			
	Total	195			

Table 6 presents the typical model output for the equivalent product (EQPR) collected by the retailers and sent to the manufacturer, based on contractual agreements with the SCN for such collection. Our analysis

only presents the collected EQPR sent by the retailers to manufacturer 1 (out of 9 manufacturers). Retailer 4, for example, collected 927 units of EQPR 1 and sent them to manufacturer 1 (Table 6). The model decides to send the collected EQPR to the manufacturers based on their capability, capacity, cost and quality affiliation level.

Table 7 presents the typical model output for inputs recovered by manufacturers from the EQPR received through retailers. Our analysis shows the inputs recovered by manufacturer 1 following the similar instance presented in Table 6.

Table 7: Typical Model Output on Inputs Recovered by the Manufacturer from EQPR in Table 6

Inputs	Recovered quantity by Manufacturer 1	Inputs	Recovered quantity by Manufacturer 1
1	5301	8	2172
2	5301	9	3328
3	4351	10	2127
4	4278	11	3150
5	3124	12	1996
6	1728	13	1996
7	778	14	3392

Table 7 illustrates, for example, that input 1, recovered by manufacturer 1, is 5301 units. To verify the model output in Table 7, we refer to Table 5, which shows that one unit of input type 1 is used by each of products 1, 2, 5 and 6. As such, one unit of input 1 should be recovered from products 1, 2, 5 and 6. Table 6 reveals that recovered input type 1 should be: $(1728+1023+1396+ 1154) =5301$. Each and every input recovered by manufacturer 1 can be verified using Tables 5 and 6.

Table 8 presents typical model results for the allocation of production to manufacturers at three quality levels. For example, manufacturer 1 has been allocated 3862 units of product at quality level 1, 1311 units of product at quality level 2 and 1382 units of product at quality level 3 (Table 8). It may be observed that the model allocated quality level 1 products only to the manufactures that are affiliated as HQMs or PMFs. According to Table 3, manufacturers 1, 5, 6 and 7 are affiliated at the HQM level (PMFs) for product 1. The model ensured the allocation of q1 level production for product 1 to manufacturer 1, 5, 6 and 7 in Table 8. One may verify similarly for product 2, which is also shown in Table 8.

Table 8: Allocation of Production to Manufacturers at Three Quality Levels

Product	Quality Level	Allocation of production to manufacturers								
		1	2	3	4	5	6	7	8	9
1	q1	3862				7565	3122	3998		
	q2	1311		2096		3717	508	1286	6854	480
	q3	1382				1037	1806	1149		1174
2	q1					7284	4312			
	q2	205		4577		1821	125	1078	2673	7388
	q3	819		1475		1525	1939		1823	747

As previously discussed, q3 products are made from recovered inputs, while q2 quality level products have a predefined percentage of recovered inputs, with the remaining inputs being new. Based on our previous analysis for Table 7, manufacturer 1 could recover 5301 units of type 1 recovered input. It is also clear from Table 5 that recovered input 1 is used to manufacture products 1, 2, 5 and 6. Table 8A presents manufacturer 1's production figures for products at different quality levels. It also shows (in green) the production quantity that used recovered input 1. The total of green figures is 5301. As such, the model appropriately used up recovered input type 1 for manufacturer 1.

Table 8A: Production for Manufacturer 1 at Different Quality Levels

Quality level	Production	Recovered Input 1 used		Production	Recovered input 1 used		Production	Recovered input 1 used
Product 1			Product 4			Product 7		
q1	3862	0	q1	2571	0	q1	2572	0
q2	1311	346	q2	837	0	q2	643	0
q3	1382	1382	q3	0	0	q3	777	0
Product 2			Product 5					
q1	0		q1	0	0			
q2	205	205	q2	279	279			
q3	819	819	q3	1116	1116			
Product 3			Product 6					
q1	6436	0	q1	5547	0			
q2	1601	0	q2	1617	231			
q3	0	0	q3	923	923			

Table 8A also verifies that the model allocated product types 1, 3, 4, 6, and 7 at the q1 level, based on its HQM affiliation. The model allocated only q2 and q3 level products from what remained to manufacturer 1. This model decision in 8A to allocate products at quality levels can be verified using Table 3.

Table 9 presents the total quantity of different products at three quality levels. Quantity produced at quality level q3 is $(100 * 43319) / 235965 = 18.36\%$. Quantity at q2 level = 37.16% and quantity at q1 level = 44.48%.

Table 9: Model Output on Production Quantity at Three Quality Levels

Quality Level	Quantity produced for products							Total
	1	2	3	4	5	6	7	
q1	18545	11595	19200	13685	14787	19738	7400	104950
q2	16253	17865	15879	5128	12033	10372	10165	87695
q3	6549	8329	9222	1842	5445	7213	4719	43319
Total	41347	37790	44301	20655	32265	37322	22285	235965

Since product return was stochastic, we asked the model to take $\beta = 30\%$ and $\alpha = 0\%$. We also specified that the model utilize 80% of the recovered inputs when producing q3, and utilize a minimum of 20% of the entire new inputs when making q2 items—deciding on q2 level products and allocating inputs for producing q3 level products. We defined the equation : $U_{im} = U1_{im} + U2_{im}$ and $U1_{im} \geq 0.8 * U_{im}$, and for new input variable $Z_{im} = Z1_{im} + Z2_{im}$ and $Z1_{im} \leq 0.8 * Z_{im}$ for all i and m .

Finally, we defined $\sum_{p,q} Xq3_{pqr} PPR_{pqi} = U1_{im}, \forall i, m$ and $\sum_{p,q} Xq1_{pqr} PPN_{pqi} = Z1_{im}, \forall i, m$

In the example problem, the returned products (EQPR) were 22% of the total demand. Using these EQPR and the recovered inputs obtained from EQPR, the model could manufacture 18.36% of q3 level products utilizing 80% of each type of recovered inputs while the remaining 20% were utilized to make q2 quality level products. The model produced 87695 units of q2 quality level product (37.16%). Within quality level q2 the model used a mixture of 12.13% recovered inputs and 87.87% new inputs on average. The overall profit generated by the solution is approximately \$29 million, and considers the restrictions imposed by various percentage parameters. Users can experiment with the mixing of inputs for q2 products and the allocation of recovered inputs for q3 products based on the importance they would like

to impart on said products at various quality levels. The model would generate a solution for maximizing profit that considers the returned products, costs and restrictions imposed.

Based on the above analysis, it is evident that the model effectively handled a collection of returnables (Table 6) from consumers engaged in contractual agreements with retailers. The model took care of the recovery process (Table 7) and used the recovered inputs in the manufacturers' production (Table 8). The model also created a what-if type of decision process for deciding production quantity at different quality levels.

5. CONCLUSION

This research introduces an MIP-based modeling approach for integrating RL in the SCN planning process with the goal of improving overall business performance. The proposed model created a customer focused, practicable and cost-effective provision for collecting (end-of-life, defective or warranty) products returned by consumers through retail outlets. The research also included an approach for managing the recovery of components/usable inputs from returned products that involved recovery service providers working in a team with the manufacturers. This approach ensures the quality, necessary expertise and optimum cost for the recovery of components/usable inputs under the guidance and management of quality affiliated manufacturers.

The model effectively decided optimum production quantity by considering the production of multiple products at three quality levels (q1, q2 and q3). The model output ensured that q1 products would be produced with new components/inputs and q3 products would only be produced with recovered inputs, leaving q2 products to be produced with a predefined mixture of new and recovered inputs. The model facilitates SC managers in defining product mix percentage at different quality levels by taking a "what-if" analysis approach for obtaining optimum SCN performance. Finally, the model ensured the quality level of products by allocating production to manufacturers with appropriate quality affiliations.

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Introduction

Researchers have long noted difficulty in estimating individual consumers' timing of discrete durables purchases (Eberly 1994; Leahy and Zeira 2005). Models developed by economists generally utilize expenditures as a proxy for consumption; however, consumer durables exhibit "lumpy" expenditures but offer continuous consumption (Bernanke 1984; Frederick, Loewenstein et al. 2002). This proposal seeks to investigate consumer perceptions, expectations and response to a specific consumer durables incentive offered on automobiles and resulting in dramatically higher than expected program participation by consumers. On July 24, 2009, the implementation rules for the Consumer Assistance to Recycle and Save Act (CARS) were issued by the National Highway Traffic Safety Administration with funding of one billion dollars and a planned duration of four months (NHTSA 2009). The CARS program was enacted with a three-fold objective. First, improving the overall fuel efficiency of the automotive fleet in operation within the U.S. today; second, reducing vehicle emissions by the automotive fleet in operation within the U.S. today; and finally, stimulating the U.S. economy through the manufacture and sale of automobiles. Unlike typical tax credits which are claimed on a consumer's annual tax return, a unique component of the CARS program is an upfront credit of \$3,500 to \$4,500 for qualifying transactions. Within days of the announcement of the final program rules and guidelines, consumer participation exceeded all expectations of consumer response leading to the depletion of the program's funding over period of a few days versus the planned four month program duration (Boles 2009). I propose to examine the consumer perceptions, expectations and response to this government sponsored incentive program resulting in dramatically higher than expected program participation by consumers.

Literature Review

Information Search and Deal Knowledge

Prior studies have shown there is heterogeneity among consumers in the attention spent monitoring prices and deals (Krishna 1994). These studies lead us to understand that some consumers are continuously checking on prices (Dickson and Sawyer 1990) and deals (Krishna, Currim et al. 1991) (Krishna 1992) and

subsequently develop a better understanding of product price over time. Other studies have indicated that consumer's purchase behavior is not only influenced by the current price of a product, but also by the price a consumer expects to see in the future (Jacobson and Obermiller 1990; Kalwani and Yim 1992). In the case of the CARS program, a consumer incentive was announced in June of 2009 by the U.S. Congress, pending the issuance of final program rules by the National Highway Traffic Safety Administration in July of 2009. These government announcements coupled with industry advertising made "deal information" available to consumers and incorporated a planned termination point for the incentive or "deal" thus potentially establishing both a current and expected future price point for consumers. This leads to my first hypothesis:

H₁ A consumer's depth of awareness of "deal information" will be positively related to the likelihood to facilitate a CARS transaction.

Reference Price and Incentive Value Effects

"Of all the tools available to marketers, none is more powerful than price"; therefore, price promotion has become an increasingly larger proportion of marketing budgets and a critical aspect in consumer's choices (Han, Gupta et al. 2001). In response to various price promotions consumers develop reference prices for various goods and marketers utilize various forms of price promotion with varying durations creating reference prices. "A reference price advertisement is one in which a lower current price is compared with a higher price previously offered (Howard and Kerin 2006)." A large body of research in marketing literature confirms the presence of reference price effects and explores variations in the effects of dollars off versus percent off advertisements (Biswas and Blair 1991); however, in the case of CARS a universal tax credit is offered in two amounts (\$3,500 or \$4,500) to any qualifying consumer at any participating retailer regardless of vehicle brand. In light of the universal offering I propose to examine the impact of the value of the incentive offered in relation to the durable goods expenditure being considered. Leading to my second hypothesis:

H₂ As a consumer's estimation of the value of the tax incentive over the actual value of their trade-in vehicle increases they will perceive a lower reference price and be more likely to facilitate a CARS transaction.

Consumer Confidence

It is well documented that individual expenditures on durables decline in periods of economic instability (Hassler 2001). In times of economic uncertainty households "allow their stocks of durables depreciate" (Bernanke 1984) or more simply stated they defer durables purchases when the investment is irreversible or costly to reverse. Some researchers have even proposed that a consumer's normal state of action with regard to durables purchases is one of "usually doing nothing" requiring a significant series of events or influences to facilitate a durables purchase (Bar-Ilan and Blinder 1992). In particular, a consumer's expectation or confidence in the stability of future income plays a significant role in moving inertia toward a durables purchase (Bertola, Guiso et al. 2005). (Eberly 1994) refers to this phenomenon as "inaction range" and notes that the inaction range increases when income variability increases (Eberly 1994). In light of these studies it is important to examine a consumer's level of confidence in future income or earnings in relationship to the likelihood of transacting a durable goods purchase:

H₃ Consumers exhibiting higher levels of consumer confidence will be positively related to the likelihood to facilitate a CARS transaction.

Methodology

The nature of consumer durable products is characterized with high purchase prices and relatively long interpurchase cycles (Bayus 1991). As the purpose of this study is to measure consumer intent toward a large consumer durable product, automobiles, a purchase a survey interview experiment design is proposed to interview a randomly selected sample of student, faculty and staff study participants at a southeastern university. The utilization of randomly selected students, staff or faculty in a university setting is frequently

used to approximate behavior of the general population with regard to purchase-decision behavior (Chenting, Edward et al. 2003; Devon, Krishnan et al. 2007).

Conceptual Model

< = = = Insert Figure 1 about here = = = >

Dependant Variable

The dependant variable to be evaluated is a consumer's likelihood or intent to participate in the CARS program by transacting an automobile purchase. Prior research in social psychology suggests that consumer intentions "should be the best predictor of an individual's behavior because they allow each individual to independently incorporate all relevant factors that may influence his or her actual behavior" (Martin, Wayne et al. 1998); Fishbein and Ajzen 1975). While self-reported intention is noted as a strong predictor of consumer behavior, researchers have noted the limitation that purchase intentions do not always result in actual purchase behavior (Martin, Wayne et al. 1998). Over the past fifty years a large body of empirical research has developed in modeling the variation between consumer intent and actual purchase (Tobin 1959; Martin, Wayne et al. 1998). These researchers note the importance of framing questions of intent in terms of a time horizon affording the potential to apply various models predicting the degree of accuracy of stated intent and/or the execution of a follow-up study measuring purchase activity against stated intent (Martin, Wayne et al. 1998).

Independent Variables:

Depth of Knowledge of Program Parameters "Deal Knowledge"

Advertising messages commonly achieve a level of attention to attract media coverage compounding the effective message communication (Jin 2003). An intense level of coverage has been achieved for the CARS program as a Google search returns over 2.7 million results and a search of headlines for articles in The Wall Street Journal's online version returns over 160 articles over a period of 60 days. Message awareness or recall is often cited as an important factor in consumer decision making (Lee 2000; Jin 2003). This study proposes to measure the affect of the depth of knowledge of the CARS program elements and parameters with regard to intent to transact a consumer durables purchase.

Perceived Incentive Value – Reference Price

Consumer perceptions with regard to price and timing of incentives is cited as an important determinate in the timing of a decision to transact a consumer durables purchase (Howard and Kerin 2006). This study

proposes evaluating the role of the CARS program effect of temporarily lowering a consumer's reference price for a consumer durable (an automobile) through a limited time increase over the market value of a consumer's trade-in vehicle. In effect this program element is hypothesized to lower a consumer's reference price for the purchase of a new automobile. As noted earlier, certain consumers are believed to monitor durables prices forming expectations for current a future prices of a durable good leading to a sense of "deal knowledge" (Howard and Kerin 2006). This study will measure the impact of this deal knowledge with regard to intent to transact a CARS purchase.

Consumer Confidence in future income/earnings

As consumer expectations of future income and earnings have been noted to have significant influence over a consumer's willingness to transact a large durables purchase, consumer confidence in future earnings and income will be measured against intent to transact a CARS purchase (Bertola, Guiso et al. 2005).

Implications

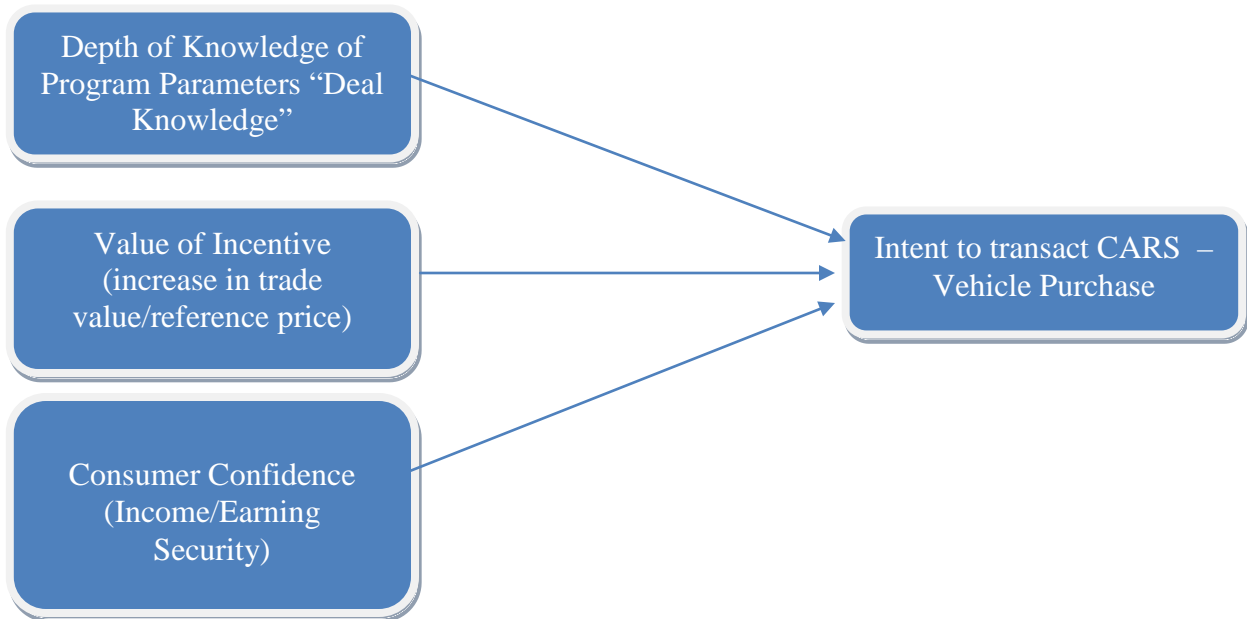
This research is proposed as an application of existing theory to gain additional understanding into prompting specific consumer behavior in the setting of a government sponsored incentive program targeting high cost consumer durables in a period of high economic uncertainty. This understanding is hoped to provide useful insights to industry participants.

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Figure 1: Concept Model



Gender and Generational Differences in Perceptions of High Speed Internet Importance

This paper is a work in progress examining differences in demographic characteristics, specifically gender and age, in consumers' use of the internet for various online activities. The data is a sub-sample of data collected by the Pew Internet and This American Life in April of 2009.

Age

Although internet access and use has become the norm, there continues to be differences in online behavior related to age. Young adults use the internet more frequently and for longer periods of time (Lyons 2004) and age has been found to be significantly related to online information gathering and shopping behavior. For example, 26-45 year olds are more likely to go online for information for travel and tourism and to make travel arrangement than other age groups (Webber and Roehl 1999). Chen and Hitt (2002) found that age and education are related to surfing (switching) behavior online. Thus the following research question is posited:

R1 - Older (younger) respondents will place less (more) importance on high-speed internet connections

Gender Differences Using the Web

Gender differences exist regarding online activities and attitudes. For instance, Teo (2001), found females were more likely to engage in messaging activities online while males were more likely to use the internet for downloading files and purchasing with males more likely to be heavy and medium internet users (Koragaonkar and Wolin, 2002). However Ono and Zavodny (2003) reported no difference in internet access between males and females but did find differences in the frequency and intensity of internet use with males tending to be online more frequently and for longer periods of time.

In terms of internet shopping, gender is related to attitudinal differences, with women having more favorable attitudes toward online shopping and using value optimizing strategies

more frequently than men (Alreck and Settle, 2001). Girard, Koragaonkar and Silverblatt (2003) found that men shopped online as a convenience. In another examination of gender differences in online buyer behavior, men were found to be more likely to purchase online (Van Slyke Communale and Belanger 2002 and Sin and Tse 2002). These findings lead to the following research proposition.

R2 - There will be gender differences in the importance ratings of high-speed internet connections

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Descriptives

Q46a How important do you think a high-speed internet connection is for each of the following? -		N	Mean	Std. Deviation	Std. Error
Finding out what is going on in your community	Gen Y (18-32)	247	1.85	.815	.052
	Gen X (33-44)	226	1.85	.873	.058
	Trailing boomers (45-54)	192	2.00	.932	.067
	Leading boomers (55-63)	142	2.11	.973	.082
	Matures (64-72)	77	2.19	.960	.109
	After work (73+)	28	2.29	.897	.169
Contributing to economic growth in your community	Gen Y (18-32)	247	2.05	.918	.058
	Gen X (33-44)	226	2.08	.999	.066
	Trailing boomers (45-54)	192	2.23	1.008	.073
	Leading boomers (55-63)	142	2.30	1.024	.086
	Matures (64-72)	77	2.38	1.101	.125
	After work (73+)	28	2.57	1.034	.195
Communicating with government officials about issues	Gen Y (18-32)	247	2.11	.963	.061
	Gen X (33-44)	226	2.15	1.082	.072
	Trailing boomers (45-54)	192	2.43	1.090	.079
	Leading boomers (55-63)	142	2.37	1.114	.093
	Matures (64-72)	77	2.53	1.071	.122
	After work (73+)	28	3.00	.981	.185
Sharing your views with others about key issues	Gen Y (18-32)	247	2.13	.928	.059
	Gen X (33-44)	226	2.28	1.057	.070
	Trailing boomers (45-54)	192	2.32	1.027	.074
	Leading boomers (55-63)	142	2.53	1.103	.093
	Matures (64-72)	77	2.42	1.092	.124
	After work (73+)	28	2.57	1.230	.232
Communicating with health care or medical providers	Gen Y (18-32)	247	1.95	.984	.063
	Gen X (33-44)	226	2.08	1.036	.069
	Trailing boomers (45-54)	192	2.09	1.057	.076
	Leading boomers (55-63)	142	2.24	1.104	.093
	Matures (64-72)	77	2.26	1.105	.126
	After work (73+)	28	2.93	1.016	.192
Total		912	2.11	1.056	.035

ANOVA

Q46a How important do you think a high-speed internet connection is for each of the following? -		Sum of Squares	df	Mean Square	F	Sig.
Finding out what is going on in your community	Between Groups	16.488	5	3.298	4.114	.001
	Within Groups	726.245	906	.802		
	Total	742.732	911			
Contributing to economic growth in your community	Between Groups	16.410	5	3.282	3.323	.006
	Within Groups	894.814	906	.988		
	Total	911.224	911			
Communicating with government officials about issues	Between Groups	35.542	5	7.108	6.396	.000
	Within Groups	1006.875	906	1.111		
	Total	1042.417	911			
Sharing your views with others about key issues	Between Groups	17.790	5	3.558	3.331	.005
	Within Groups	967.858	906	1.068		
	Total	985.648	911			
Communicating with health care or medical providers	Between Groups	29.633	5	5.927	5.447	.000
	Within Groups	985.735	906	1.088		
	Total	1015.367	911			

Descriptives

Q46a How important do you think a high-speed internet connection is for each of the following? -		N	Mean	Std. Deviation	Std. Error
Finding out what is going on in your community	Male	449	2.06	.908	.043
	Female	463	1.87	.889	.041
	Total	912	1.96	.903	.030
Contributing to economic growth in your community	Male	449	2.19	1.018	.048
	Female	463	2.16	.983	.046
	Total	912	2.18	1.000	.033
Communicating with government officials about issues	Male	449	2.38	1.075	.051
	Female	463	2.20	1.058	.049
	Total	912	2.29	1.070	.035
Sharing your views with others about key issues	Male	449	2.33	1.052	.050
	Female	463	2.28	1.029	.048
	Total	912	2.31	1.040	.034
Communicating with health care or medical providers	Male	449	2.22	1.076	.051
	Female	463	2.01	1.027	.048
	Total	912	2.11	1.056	.035

ANOVA

Q46a How important do you think a high-speed internet connection is for each of the following? -		Sum of Squares	df	Mean Square	F	Sig.
Finding out what is going on in your community	Between Groups	7.643	1	7.643	9.461	.002
	Within Groups	735.090	910	.808		
	Total	742.732	911			
Contributing to economic growth in your community	Between Groups	.230	1	.230	.230	.632
	Within Groups	910.994	910	1.001		
	Total	911.224	911			
Communicating with government officials about issues	Between Groups	7.390	1	7.390	6.497	.011
	Within Groups	1035.027	910	1.137		
	Total	1042.417	911			
Sharing your views with others about key issues	Between Groups	.595	1	.595	.549	.459
	Within Groups	985.053	910	1.082		
	Total	985.648	911			
Communicating with health care or medical providers	Between Groups	9.811	1	9.811	8.879	.003
	Within Groups	1005.556	910	1.105		
	Total	1015.367	911			

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Technology
Special Session
Hal Wilson, National Security Agency**

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- **Applicants should be enrolled in an MS or PhD programs and have the skills to do OR/M&S work.**
- **Applicants should be returning to school following the internship. Highly qualified graduating seniors are also welcome to apply if they will be entering into a graduate program.**
- **Applicants must have a cumulative grade point average of at least 3.0 on a 4.0 scale.**
- **Applicants must successfully complete and extensive background investigation and a polygraph to obtain a security clearance.**

The Green Single Vehicle Routing Problem

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ABSTRACT

This paper introduces a new version of the traditional Vehicle Routing Problem (VRP). The objective function of the VRP is to minimize the total distance traveled by a set of vehicles serving a set of customers. This research proposed a new objective function that minimizes Ton-Miles. Fuel consumptions and consequently CO₂ emissions are a function of Ton-Miles instead of total distance travelled by the vehicles. More exactly, this research presents the case for a single vehicle. This work includes a mathematical formulation of the problem; a small instance that illustrate the problem, and a local search technique that can be used in future approximation algorithms. The new problem is called the Green Single Vehicle Routing Problem (GSVRP).

INTRODUCTION

The vehicle routing problem (VRP) is the scheduling of a set of vehicles that serves a group of customers such that the total distance traveled by the vehicles is minimized. The VRP was first introduced by [1] and have been widely studied in the literature. In fact, the VRP was proved to be NP-Hard by [2]. It means that there is no algorithm that guarantee solution optimality for larger problem instances in acceptable computational times.

The VRP has applications in the transportation and logistics fields. Moreover, any company such as FedEx and UPS that scheduled vehicles to serve customers need to solve VRP routinely. There are different versions of the problem according to the assumption considered. For example, there are VRP that allow customers to be visited only once, while others allow customers to be visited more than once. Also, there are versions of the problem that only pickup or deliver products to customers, while others allow simultaneously pickup and delivery. For a detailed description of the different versions of the VRP the reader is referred to [3] [4] and [5].

As mentioned above, the most common objective function among VRP is to minimize total distance travelled by the vehicles. An alternative and more environmentally friendly objective for the problem is to minimize fuel consumptions or CO₂ emissions. Therefore, minimizing total Ton-Miles travelled by the vehicle would minimize fuel consumption and consequently CO₂ emissions. The purpose of this paper is to introduce a new version of the VRP that minimizes Ton-Miles. Moreover, the problem presented in this research considers only one vehicle and is called the Green Single Vehicle Routing Problem

(GSVRP). In addition, it is important to mention that the single VRP is the same as the Travelling Salesman Problem (TSP), which was proved NP-Hard by [2]. Since the GSVRP is a generalization of the single VRP and the TSP, the GSVRP is also computationally difficult. Therefore, approximation algorithms such as Simulated Annealing and Tabu Search are required to solve large instances in acceptable computational time.

The remaining of this paper is as follows: Section 2 formally introduces a mathematical formulation for the GSVRP. Section 3 illustrates the problem using a small problem instance. Section 4 illustrates a local search algorithm. Finally, section 5 summarizes this work and proposes future avenues of research.

PROBLEM DESCRIPTION

Properly, the GSVRP can be defined as follows: Given a set of customers that need to be served by one vehicle, the GSVRP is to find the route that visits each customer exactly once and return the vehicle to the depot such that the total Ton-Miles accounted is minimized.

Mathematical Formulation

The mathematical formulation for the GSVRP presented below is build over the traditional formulation of the TSP. Following are the indexes, parameters, variables, objective function, and constraints of the mixed linear integer programming for the GSVRP.

Indexes:

i, j Locations: $i, j = 0, 2, \dots, L$; where 0 represents the location of the depot.

Parameters:

d_{ij} Distance between locations i and j .
 q_j Customer j demand.
 W Vehicle weight including all the cargo.

Variables

x_{ij}^k : 1 if vehicle serves location j immediately after serving location i .
 0 otherwise.
 y_{ij} Weight of vehicle traveling between locations i and j .
 u_i Arbitrary real variable.

Objective function:

$$\text{Min} \sum_{i=0}^L \sum_{j=0}^L d_{ij} y_{ij} \quad i \neq j \quad (1)$$

Subject to

$$\sum_{i=0}^L x_{ij} = 1 \quad \forall j \neq i \quad (2)$$

$$\sum_{i=1}^L x_{ij} = 1 \quad \forall i \neq j \quad (3)$$

$$\sum_{j=0}^L y_{0j} = W \quad (4)$$

$$\sum_{i=1}^L y_{ij} - \sum_{i=1}^L y_{ji} = q_j \quad \forall j, i \neq j \quad (5)$$

$$y_{ij} - Wx_{ij} \leq 0 \quad \forall i, j, i \neq j \quad (6)$$

$$u_i - u_j + Lx_{ij} \leq L - 1 \quad (7)$$

$$x_{ij} \in [0,1] \quad \forall i, j, i \neq j \quad (8)$$

$$u_i \geq 0 \quad \forall i \quad (9)$$

Objective function (1) minimizes total ton-miles. Constraint set (2) ensures that the vehicle arrives to each location once. Constraint set (3) ensures that the vehicle leaves each location once. Constraint set (4) ensures that the initial weight of the vehicle includes its own weight and the weight associated to customer demands. Constraint set (5) guarantees flow conservation. Constraint set (6) ensures that vehicle weights are in concordance with the tour order. Constraint set (7) eliminates sub-tours. Constraint sets (8) and (9) restrict decision variables. Notice that constraint sets (2), (3) and (7) are from the TSP formulation and constraint set (6) link TSP constraints with the additional parts of the GSVRP formulation.

PROBLEM INSTANCE

The GSVRP will be illustrated using a small problem instance. The instance considers a single vehicle with a curb weight (i.e., weight of the empty vehicle) of 8 tons. More over the vehicle will delivery cargo to 5 customers. The customer demands are 1.5 ton for customer 1, 0.50 ton for customer 2, 3.5 ton for customer 3, 3.5 ton for customer 4, and 0.5 ton for customer 5.

Table 1 shows the distance between each pair of locations. Moreover, location 0 represents the vehicle depot.

	0	1	2	3	4	5
0	0	33.5	30.4	22.4	17.1	22.4
1	33.5	0	20.0	21.2	26.9	20.6
2	30.4	20.0	0	22.2	25.0	25.0
3	22.4	21.2	22.2	0	25.8	24.1
4	17.1	29.9	25.0	25.8	0	15.8
5	22.4	20.6	25.0	24.1	15.8	0

Table 1: Distances between locations (location 0 represents the depot)

The optimal solution of the problem instance was obtained by solving the mathematical formulation above with lp_solve 5.5. The optimal solution is showed in the left part of table 2. Notice that the route that minimizes Ton-Miles is $S = \{0, 4, 3, 2, 1, 5, 0\}$, where S shows the sequence in which customers should be visited. The route has Ton-Miles 1405.3 and the total distance travelled by the vehicle is 128.1

miles. On the other hand, when the problem is solved using a TSP mathematical formulation with lp_solve 5.5 (i.e., minimizing the total distance traveled by the vehicle), a different solution $S = \{0, 3, 2, 1, 5, 4, 0\}$ is obtained. Notice that the total number of miles is 10 miles less than the GSVRP, but Ton-Miles is 100.9 higher. The details of the TSP solution are showed in the right side of table 2.

GSVRP Optimal solution					TSP Optimal solution				
Tour	Distance	Demand	Vehicle Weigh	Ton-Miles	Tour	Distance	Demand	Vehicle Weigh	Ton-Miles
0					0				
	17.1		17.0	290.7		22.4		17	380.8
4		3.5			3		3.5		
	25.8		13.5	348.3		22.2		13.5	299.7
3		3.5			2		0.5		
	22.2		10.0	222.0		20.0		13.0	260.0
2		0.5			1		1.0		
	20.0		9.5	190.0		20.6		12.0	247.2
1		1.0			5		0.5		
	20.6		8.5	175.1		11.5		11.5	181.7
5		0.5			4		3.5		
	22.4		8.0	179.2		17.1		8.0	136.8
0					0				
TOTAL	128.1			1405.3	TOTAL	118.1			1506.2

Table 2: GSVRP and TSP optimal solutions.

LOCAL SEARCH TECHNIQUE

Since the GSVRP is computationally difficult, approximation algorithms are required for solving large size problem instances. Approximation algorithms such as Tabu Search and Simulated Annealing use Local Search (LS) techniques (LS) in their exploration of the problem solution space. LS require a solution representation and a mechanism to explore neighboring solutions. A solution for the GSVRP can be represented as a vector $S = \{s_0, s_1, \dots, s_L, s_{L+1}\}$ showing the order in which customers will be visited. Moreover s_0 and s_{L+1} represent the vehicle depot and can be omitted from the solution representation. For example a solution for the problem can be represented as $S = \{3, 2, 1, 5, 4\}$ where $s_1=3$, $s_2=2$ and so on. Notice that LS needs an initial solution. Commonly, initial solutions are provided by construction algorithms. A simple construction algorithm for the GSVRP is to assign customers in sequential order, that is $S = \{1, 2, 3, 4, 5\}$. Once an initial solution is obtained for LS, the new solution becomes the current solution.

Among the most effective mechanism to explore neighboring solutions is 2^{opt} . A 2^{opt} mechanism exchange two customers in the current solution S . For example a 2^{opt} move could exchange customers 3 and 2 in S leading to a new neighboring solution $S^* = \{2, 1, 3, 4, 5\}$. Once the move is performed, the objective function value (i.e., Ton-miles) of the solution is obtained. The 2^{opt} mechanism is repeatedly applied to S until all possible 2^{opt} moves are evaluated. Once all the moves are performed (i.e., the solution neighborhood have been explored) the best solution is selected and it becomes the new current solution S .

The process is repeated until there is no more improvement in solution quality. That is, no neighboring solution is better than the current solution.

CONCLUSIONS AND RECOMMENDATIONS

This paper introduces a new version of the VRP that considers a different and more environmental friendly objective function for the VRP. The new objective function minimizes Ton-Miles instead of total distance travelled by the vehicle. Consequently, the new version minimizes fuel consumption and CO₂ emissions. A mathematical formulation for the problem is presented. In addition, the problem is illustrated using a small problem instance. Also, a 2^{opt} LS is discussed. Finally, areas for future research for the GSVRP include generating a test dataset and developing efficient metaheuristics such as tabu search, simulated annealing or Ant Colonies.

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STATISTICAL SOFTWARE PRICE MODELING

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ABSTRACT

The academic literature offers little guidance regarding software pricing. The authors, building on their earlier attempts, offer modeling techniques involving artificial intelligence and statistical approaches to broach the problem. The technique is applied to 2009 Statistical Software Survey data published in OR/MS Today.

INTRODUCTION

Computers play a critical role in our lives today. Computers consist of two key parts – hardware and software. The academic literature is replete with examples of modeling approaches that estimate prices of computers having various hardware components [2][8][9]. The same, however, is not true about computer software. Most of the approaches have focused on usage or creation costs [1][3][5][11]. Part of the problem may be that software is not made up of “components”. It is basically designed to perform a certain function. The authors have attempted to exploit the attributes of software and used them to assess software prices in the academic and business markets. The approach makes it possible to estimate the prices of academic and business software that possess certain attributes. In addition, the analysis performed also identifies the key variables that influence the software prices for both academic and business markets. The approach is illustrated using the 2009 Statistical Software Survey data published in OR/MS Today [12].

The raw statistical software survey data in OR/MS today was qualitative in nature. It was converted to quantitative form using EXCEL commands. The variable OS-WINDOWS was removed since it had no variability across the different software surveyed. All data points that were missing software prices were

ignored. All ranges were converted to the mid-point value. All non-U.S. currencies were converted to U.S. dollars using the currency rates on 1/13/2010.

The paper is organized in the following manner. The first section discusses the data elements. It applies a backward propagation neural network to map the various input variables onto the output variables (prices). The resulting output and its meaning are discussed. The second section applies a factor analysis approach to reduce the number of modeling variables. The results are compared with variables showing a high contribution value in the first section. The third section applies the stepwise regression technique to the dataset. Its finding is compared with results of the previous sections. The last section summarizes the overall results and discusses the limitations of the approach and suggests some implications for managers.

The Neural Network Approach

The OR/MS data included values for 28 variables. Two of these were software prices for the academic and the business market, the other 26 are listed in figure 1. The additional information provided, e.g. vendors, typical applications, primary markets served by the software, vendor comments, new features, etc. was too varied and qualitative to use in the modeling process. All 26 variables listed were used as input for the neural network approach.

Neural networks are a well-established statistical technique in the literature. Its modeling and predictive ability has often been touted as superior to conventional statistical approaches [6][7][10]. Mapping all 26 input variables into the software pricing variables produces two models, one for predicting academic software prices, the other one for business software prices. To facilitate the modeling process, the Predict software produced by NeuralWare, Inc. was chosen [4]. The software has a wizard to facilitate the data classification process. Once the input and output variables have been identified, the wizard allocates one neuron per input and attempts to create a neural network using a training and testing

phase. About 20% of the data are kept aside for testing. During the training phase, both the input variables and the desired values of output variables are presented to the neural network. A trained network is tested by asking the neural network to predict the output value for a given set of input variables. The characteristics of the models are shown in figure 2.

VARIABLE DESCRIPTION	VARIABLE	VARIABLE DESCRIPTION	VARIABLE
Memory Needed	RAM	Cost allocation	COSTING
Operating System1	OS-MAC	Mixed Discrete and Continuous	MIX -DIS-CONT
Operating System2	OS-LINUX	Animation	ANIMATION
Icon Drag and Drop	ICON-DROP	Real-time viewing	REALTIME
Access to Modules	MODULES	Export Animation	EXP-ANIM
Run time debug	RUNTIME-BUG	Compatible animation software	ANIM-SOFT
Input Distribution Fitting	INPUT-FIT	3D Animation	3D-ANIM
Output Analysis Support	SOLN-HELP	Import CAD drawings	IMPORT-CAD
Batch run or experimental design	BATCH	Hotline	HOTLINE
Optimization	OPTIMAL	User group or discussion area	USER-GRP
Reuse of Code	CODEREUSE	Training Courses	TRAIN-COURSE
Model Packaging	MODELPACK	On site Training	TRAIN-SITE
Extra cost for model packaging	EXTRACOST	Consulting Available	CONSULT

Figure 1: Input Variables for the Neural Network Model

ACAD	R	Net-R	Avg. Abs.	Max. Abs.	RMS	Accuracy 20%	CI (95%)
Train	0.7583	0.5933	96	980	273	0.8696	566
Test	0.7859	0.6066	84	980	240	0.8824	487

BUSI	R	Net-R	Avg. Abs.	Max. Abs.	RMS	Accuracy 20%	CI (95%)
Train	0.8895	0.7125	3155	36740	8192	0.9565	16986
Test	0.7869	0.6675	3001	36740	7168	0.9706	14553

Figure 2: Results of Neural Network Training and Testing

A simple description of the tabulated values is as follows:

R: Linear correlation between the actual output and the model output.

Net-R: Linear correlation between the actual output and the raw neural net output.

Avg. Abs.: Average absolute error between the actual output and the model output.

RMS: Root mean square error between the actual output and the model output.

Accuracy Measure: Fraction of model output that are within 20% of actual output.

Confidence Limits: Predicted values are within this distance of target values with 95% confidence.

The academic model shows a lower R, Net-R, RMS, and accuracy than the business model. Despite this, however, both models are quite acceptable. The academic model predicts results within 20% of the desired value 88% of the time, while the business model does the same 97% of the time.

ACAD			BUSI		
Variable	Mean	Variance	Variable	Mean	Variance
RAM	-0.598	0.971	3D-ANIM	0.145	0.013
ANIM-SOFT	-0.698	0.702	MIX -DIS-CONT	0.114	0.008
MODULES	-0.664	0.522	MODELPACK	-0.098	0.006
OS-LINUX	0.325	0.148	TRAIN-SITE	-0.097	0.006
INPUT-FIT	-0.290	0.126	MODULES	-0.091	0.005
EXTRACOST	0.187	0.044	BATCH	0.063	0.002
TRAIN-SITE	-0.116	0.021	CODEREUSE	0.045	0.001
ANIMATION	0.094	0.013	EXP-ANIM	-0.034	0.001
OS-MAC	0.057	0.007			
OPTIMAL	0.021	0.005			
RUNTIME-BUG	0.057	0.005			
EXP-ANIM	0.001	0.004			

Figure 3: Mean and Variance Values for Sensitivity Analysis for NN Models

Sensitivity analysis in a Predict model helps us determine the effect of small changes in an input value on the price. This can be quite insightful. To facilitate analysis, it also ranks the input fields according to this sensitivity. Mathematically, sensitivity analysis is a basically a matrix of partial derivatives of output variable with respect to input variables.

Sensitivity analysis has the potential of providing good modeling insights. If the input values can be controlled (i.e. the software attributes can be adjusted) sensitivity analysis shows which fields should be

changed and in which direction to achieve the desired software price. A positive mean value implies that increasing the input value will increase the output by the mean value (on average), while a negative mean value implies that increasing the input value will decrease the output by the mean value (on average). It is important to note that highly sensitive fields may not necessarily be important fields for an application.

To study the sensitivity of an input variable with respect to the price, the input variable's value is altered while keeping all other inputs constant and the change in price is noted. This procedure is used on all variables, for all observations, for both models. The mean and variance values for the sensitivity analysis for both models are shown in period 3. Variables not shown in the table had no impact on software price. Software for the academic market shows high sensitivity to RAM (memory needed, sensitivity = -0.598), ANIM-SOFT (compatible animation software, sensitivity=-0.698), and MODULE (access to modules, sensitivity=-0.664). Software for the business market shows high sensitivity to 3D-ANIM (three dimensional animation, sensitivity= 0.145), MIX-DIS-CONT (mixed discrete and continuous, sensitivity= 0.114), and MODELPACK (model packaging, sensitivity= -0.091). In general, the business software prices showed much lower price sensitivity compared to academic software prices.

To gauge the contribution of each variable towards software price, the Predict software performs a contribution analysis. To implement it, the model is run in standard mode for the current record. For each non-missing field in turn, its value is replaced by the mid-range value and a modified output is calculated. The absolute difference between the original neural net output and the modified neural net output is calculated for each non-missing field. This is referred to as the "delta" for the non-missing field. The delta is scaled on a 100 point scale. Figure 4 shows the contribution analysis result.

CONTRIBUTION ANALYSIS (ACAD)	
ANIM-SOFT	38
BATCH	3
COSTING	2
EXTRACOST	10
INPUT-FIT	11
MODULES	14
OS-LINUX	25
OS-MAC	4
RAM	9
REALTIME	6
TRAIN-COURSE	7
USER-GRP	3

CONTRIBUTION ANALYSIS (BUSI)	
IMPORT-CAD	40
3D-ANIM	23
ANIMATION	5
ANIM-SOFT	1
BATCH	15
CODEREUSE	5
MODELPACK	11
OPTIMAL	3
OS-LINUX	29
OS-MAC	2
RAM	1

Figure 4: Contribution Analysis Results for Both Models

The software price for the academic market was influenced the most by ANIM-SOFT (compatible animation software, contribution=38), OS-LINUX (LINUX operating system, contribution=25), and MODULES (access to modules, contribution=14). The business market on the other hand was influenced most by IMPORT-CAD (import CAD drawings, contribution=40), OS-LINUX (LINUX operating system, contribution=29), and 3D-ANIM (three dimensional animation, contribution= 23).

The Factor Analysis Approach

The dataset consists of 26 input variables. Several of them appear to be related because of the issues involved (e.g. operating system, input/output, etc.) With an attempt to simplify the predictive modeling process by reducing the number of variables, factor analysis was performed using SPSS. The Varimax rotation procedure identified several underlying variables that explained most of the variation in price. Figure 5 lists these variables and compares them with the contribution analysis report presented in the previous section.

FACTOR #	VARIABLE	ACAD	BUSI
1	TRAIN-SITE		
	TRAIN-COURSE	7	
	ICON-DROP		
	BATCH	3	15
	SOLN-HELP		
	CONSULT		
	COSTING	2	
	INPUT-FIT	11	
	MIX -DIS-CONT		
	MODULES	14	
2	IMPORT-CAD		40
	ANIMATION		5
	3D-ANIM		23
	REALTIME	6	
	EXP-ANIM		
	OPTIMAL		3
	USER-GRP	3	
	RUNTIME-BUG		
3	MODELPACK		11
	RAM	9	1
	EXTRACOST	10	
4	OS-LINUX	25	29
	OS-MAC	4	2
	ANIM-SOFT	38	1
5	CODEREUSE		5
	HOTLINE		

Figure 5: Factor Analysis Results Compared with Contribution Analysis

Factor analysis produced an output from which 5 factors were extracted, having 10, 8, 3, 3, and 2 variables respectively. While the academic pricing model had significant contributions from one or more variables contained in all 5 factors, the business pricing model had the same in only 4 factors. The factor explaining the most variance (factor #1) did not have too many high contributing variables for either the business or the academic pricing model in its mix.

Getting SPSS to extract only 5 factors using Principal Component Analysis with Varimax Rotation and Kaiser Normalization, 72.66% of the total variation in software prices could be explained. The five factors were regressed versus the output variable for both academic and business markets. The results

were dismal! Both markets produced an overall regression model that was not significant (For the academic software model, $F=1.63$, $\text{significance}=0.184$; for the business software model, $F=2.31$, $\text{significance}=0.071$). The linear R was 0.475 for academic software model, and 0.540 for the business software model.

The Stepwise Regression Approach

Given the data set with 26 input variables and two output variables, the stepwise regression technique was used with each output variable. Using p-values of 0.05 to allow entry into the model, and 0.10 for exit, the stepwise regression model produced a five-variable model for both business and academic pricing models. The five-variable output for both models is presented in figure 6. The presence of the variables that made it to the final stage in the 5 factors that were extracted during factor analysis is indicated in the last column. Factors 4 and 5 are notably absent from both models. 18 out of 26 variables were present in the first two factors and those appear twice in both models.

	MODEL	Standardized Coefficients	t	Sig.	Variable Presence in Factor #
		Beta			
BUSI	(Constant)		-3.99	.0004	
	3D-ANIM	.5091	3.29	.0027	2
	SOLN-HELP	.8924	5.20	.0000	1
	MIX -DIS-CONT	-.5260	-3.80	.0007	1
	EXTRACOST	.5591	3.56	.0014	3
	REALTIME	.3945	2.28	.0307	2
ACAD	(Constant)		-3.09	.0045	
	EXTRACOST	.6856	4.63	.0001	3
	BATCH	.4993	3.03	.0052	1
	IMPORT-CAD	-.4797	-3.23	.0032	2
	USER-GRP	.3615	2.32	.0281	2
	MIX -DIS-CONT	.2840	2.18	.0375	1

Figure 6: Stepwise Regression Results for Software Pricing Models

The academic software pricing model contains the following variables: EXTRACOST (extra cost of model packaging), BATCH (batch run or experimental design), IMPORT-CAD (import CAD drawings), USER-GRP (user group or discussion area), and MIX-DIS-CONT (mixed discrete and continuous variables). The business pricing model contains the variables: 3D-ANIM (three dimensional animation), SOLN-HELP (output analysis support), MIX-DIS-CONT (mixed discrete and continuous), EXTRACOST (extra cost of model), and REALTIME (real time viewing).

The business software pricing model made selections that were quite similar to the ones made by the neural network model, with the notable exception of OS-LINUX (the LINUX operating system). The academic software pricing model, however, was lacking on most of the variables identified by the neural network model.

Results, Discussion, and Limitations

Application of various quantitative management techniques has produced varying results. The neural network application offered an analysis technique that appeared to work reasonably well. The neural network learned and trained quite well, given $R=0.79$ and higher. The sensitivity analysis and contribution analysis provided gave us a feel for the sensitivity and importance of various variables. Factor analysis identified 5 factors that explained about 72% of the variation in software prices, but the regression models involving them were not significant. The stepwise regression, on the other hand, produced a 5-variable model for both academic and business markets, using $P_{in}=0.05$ and $P_{out}=0.10$, that was significant overall, and had all its regression coefficients significant as well. However, while the business software pricing model flagged most of the variables identified by the neural network, the academic software pricing model had very little in common with the neural network approach.

There are several limitations of the study. First and foremost, the data set itself is quite small. Only 34 of the observations provided in the OR/MS data set were complete enough to be useable. With 26

independent variables, there is a need for much more data to do rigorous analysis. In addition, there were several qualitative factors specified in the OR/MS survey about different software that were hard to generalize and capture quantitatively. A more exhaustive data capturing template in future surveys may help. The second one is making use of results. Which model can be trusted? While the neural networks are noted for predicting well once they learn and test well, and their predictive abilities are regarded as superior to traditional statistical techniques, it is hard to dismiss the other techniques as unreliable. It is entirely possible that with a much larger set all three techniques would have yielded similar results from all techniques.

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THE SOCIAL SECURITY ACT OF 1935 AND THE GREAT DEPRESSION: A RETROSPECTIVE

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ABSTRACT

The conditions in the 1930s surrounding the consideration and passage of the Social Security Act have been invoked in the debate and discussion of the current health care legislation. We take a historical look at the passage of Social Security including economic and political arguments and make comparisons with the current situation.

INTRODUCTION

A major political and economic issue at the present time is the passing of a major piece of social legislation—health care—in the middle of a major recession. This attempt is often compared to the passage of Social Security legislation during the great depression of the 1930s. This paper will provide a retrospective on the Social Security Act of 1935 in relation to society and the economy with the objective of providing some insight into the present situation. We shall attempt to discover if there was adequate justification for the passing of H.R. 7260. This will not be an attempt to justify the act in terms of present day knowledge and experience, but in terms of what the people at the time of the drafting of the bill knew and had experienced. Today, as in the 1930s with Social Security, the arguments for and against the passage of the health care legislation largely depend upon forecasts and conjecture. With a hind sight of seventy-five years with Social Security, perhaps we can provide some insight into the current debate.

We shall look at the context in which Social Security was enacted, and its effect once it became law. The context consists primarily of the years of Franklin Roosevelt's first term. It will include a look at the then prevailing economic conditions in terms of the relevant indicators. The economic aspect will be a presentation of the views of the writers of the time on the effects of the Social Security Act as a stabilizing device, and, the effect of the reserve funds on the economy with some comments by post-war writers.

It must be remembered in reading this paper that the writers referred to are writing in the pre-war period before national income analysis gained much of the sophistication it claims to have today. Some of the assumptions of the writers were different from those we accept today. But for the purpose of this paper, their assumptions must be accepted, for we wish to examine if they were justified in terms of the current ideas and opinions. The other is to see if the debate over social security legislation can shed some light on the current debate over health care reform.

THE THEN CURRENT ECONOMIC CONDITIONS

This section will be divided into two main parts. The first will be an analysis of the economic conditions in the period from 1929 to 1936 as indicated by various statistics. The second will cover the problem of security at this time as seen by the authors of the times.

Table 1: Selected Economic Indicators, United States, 1929-1936.
(Statistical Abstract, 1940)

	1929	1930	1931	1932
National Income (\$ in millions)	\$82,885	\$68,901	\$54,310	\$40,074
National Income (1929=100)	100.0	81.3	65.5	48.3
Cost of Living Index	100.0	97.5	89.1	80.2
Real National Income	\$82,885	\$70,668	\$60,954	\$49,968
Population in thousands	121,526	123,091	124,113	124,974
Production 1935-39=100	110	91	75	58
Employees in thousands	35,563	33,122	29,715	26,222
Per Capita Income (\$)	\$682	\$559.70	\$437.50	\$320.60
	1933	1934	1935	1936
National Income (\$ in millions)	\$42,430	\$50,347	\$55,870	\$65,165
National Income (1929=100)	51.2	60.7	67.4	78.6
Cost of Living Index	76.2	79.1	81.1	82.1
Real National Income	\$55,682	\$63,650	\$68,890	\$79,373
Population in thousands'	125,770	126,626	127,521	128,429
Production 1935-39=100	69	75	87	103
Employees in thousands	26,133	28,402	29,725	31,858
Per Capita Income	\$337.30	\$397.60	\$438.10	\$507.40

The Indicators

The purpose of these statistics will be to point out the economic conditions leading from 1929 up to the time of the passage of the Social Security Act. The statistics are taken from several different sources, so may differ in detail. In addition to the statistics found in the sources, some others have been derived from these statistics. The derived statistics in Table 1 are those for real national income and per capita income. These were derived by dividing national income by the cost of living index and population respectively.

In Table 1, the national income figures indicate that the low point was reached in 1932 when it had shrunk more than 50 percent in nominal terms and to about 60 percent of its 1929 level in real terms. By 1935, when the Social Security Act was passed, it had risen to 67.4 percent of its 1929 level in nominal terms and 83.1 percent in real terms. Production hit its low point in 1932, and the number of employees hit bottom in 1933 (showing that then, as now, employment tends to be a lagging indicator). Per capita income also hit a low in 1932. These figures perhaps give some indication of why most of the emergency programs were proposed by the administration in the two years of 1932 and 1933. They also show that as bad as the current recession is perceived to be, its 2.4 decrease (2008-09) in national income is relatively minor compared to the so-called "Great Depression."

Table 2 contains population, employment and earnings data. As the population figures indicate, population increase slowed considerably from 1930 to 1931. Even after the other indicators showed the economy to be on its way to recovery in 1935, population was slow to begin increasing once more at an increasing rate. The labor force also continued to expand, giving the unemployment figures a slight bias, but since an expanding labor force is a normal condition, it is not a bias that causes the statistics to give a false impression. The unemployment figures reached a high point in 1933 in terms of total unemployment, unemployment as a percentage of the total population, and as a percentage of the labor force. But in 1935, unemployment was still 19.96 percent of the labor force. This indicates that although unemployment was still a major problem and was far above its low point of 1929, it seemed as though the problem was beginning to be corrected. This is in comparison with the present recession when unemployment peaked at just above 10 percent. The same situation can be seen with the average weekly earnings. The low point was reached in 1933, but recovery was under way in 1935 when the Social Security Act was passed.

The figures presented in both tables all seem to point to one thing in relation to the Social Security Act. The low point in the depression was reached before any move was made by the administration to consider such a bill. By the time it was considered, the economy seemed to be on its way to recovery. Thus, in terms of the economic indicators, there was minimal justification for passing the Social Security Bill in 1935, if one assumes it was a measure designed to assist recovery. On the other hand, the fact that the economy was recovering was justification in the minds of some for passing the bill at that time since the country could now afford a major spending initiative.

Looking at all of the figures in relation to each other, however, it seems clear that by 1935, the date of the passage of the Social Security Act, the economy showed signs of being well on its way to recovery. Thus, if the act is considered an emergency recovery program, any justification for its passage on these grounds was not as strong as it would have been two or three years previous to its passage. Strong is, of course, a relative term since there were still nine million unemployed.

Table 2. Selected Economic Indicators, United States, 1929-1936.

	1929	1930	1931	1932
Population (millions)	121.8	123.1	124.0	124.8
Population Increase		1.3	.9	.8
Labor Force (millions)	49.4	50.1	50.7	51.3
Unemployment (millions)	1.5	4.3	8.0	12.1
Unemployment (%)	3.03	8.58	15.77	23.58
Gross Avg. Weekly Earnings	\$24.76	\$23.00	\$20.64	\$16.89
	1933	1934	1935	1936
Population in millions	125.6	126.4	127.2	128.1
Population Increase	0.8	0.8	0.8	0.9
Labor Force (millions)	51.8	52.5	53.1	53.7
Unemployment (millions)	12.8	11.3	10.6	9.0
Unemployment (%))	24.71	21.52	19.96	16.75
Gross Avg. Weekly Earnings	\$16.65	\$18.20	\$19.91	\$21.56

The question does arise, however, of whether or not the Social Security Act was indeed a program for recovery. As will be seen, most congressmen felt the bill was one of reform, not recovery. Several significant differences can be seen between the Social Security Act and the other programs passed as emergency measures. Most of the other programs consisted of injecting money into the economy, while the initial effect of the Social Security Act was to remove it. Most of the other programs were made effective for a period of two to five years, while the Social Security act was effective for a theoretically infinite period of time.

There are also similarities, however. The unemployment compensation title of the act was designed as an emergency measure to maintain purchasing power in a downswing. The emphasis in the act was on security, although it was more long-run security than short-run. A judgment as to whether or not there was justification for the act on the basis of the context in which it was passed must be reserved until after the next section when the imagined effects of the act on the economy are described.

THE ECONOMICS OF THE SOCIAL SECURITY ACT

This discussion on the economics of the Social Security Act will be divided into two main sections with a shorter third section as a conclusion. The first section will deal with the more general effects of the act on the economy and business cycle. This will include its role in stability and will cover both short-run and long-run effects. The second section will deal with the effect of the reserve fund on the economy. The three areas in which the analysis will be concentrated will be income distribution, inflation and deflation, and investment. The third section will look at the act as a general fiscal tool to be used with other available fiscal tools. It is unfortunate that this important debate on the economic aspects of the act came after its passage. Little consideration was given to these issues while the bill was being drawn up and during debate on the bill. In the wake of the passage of the so-called 'Obamacare', it appears that the political process has changed little since then.

There will also be no attempt to determine the validity of the arguments presented by the proponents of the various viewpoints. There will not be a complete lack of comment, but the arguments will be presented essentially as the authors intended them to be.

Effects On the Business Cycle

This section will be divided into three headings: the role of the act in stability, its short term effects, and its long term effects. Some more recent views of the effect of the act on stability will be presented at the end of the section.

The Role In Stability

George A. Renard, Secretary-Treasurer of the National Association of Purchasing Agents pointed out that the social security legislation would help business conditions by stabilizing employment. Employers would be less anxious to hire many workers when the season is busy, and then lay them off when things are slack. Production would be on more of a long-run, consistent level which would lower cost and thus prices. (NY Times, 1935)

Meriaro, on the other hand, states that a formal social security system is a minor factor in achieving economic stability. His elaboration, however, indicates that he means it should play a minor role. The function of the social security is to provide a minimum standard of living for those who benefit under the system. The maintenance of this level with constant benefits presumes a constant price level. If inflation occurs, however, it is the duty of the politician to increase benefits and maintain real income. Rather than contributing to economic stability, social security is dependent upon it. (Meriam, 1947)

Short and Long Range Effects On Stability

Eleanor L. Dulles claimed that the immediate effect of passage of the act would be a deflationary one. This is because the main influence of the program is through its payroll taxes, which have a greater effect on spending than do more progressive taxes. (Berridge, 1938) The last phrase was left unexplained. To prove that social security and unemployment taxes are deflationary, the critics of the time pointed to the 1937 depression following on the heels of the passage of the act. The Chairman of the Federal Reserve System, Marriner S. Eccles, stated that the 1937 depression was caused in part by the deflationary effects of the withdrawing of consuming power through social security taxation. (Parker, 1942)

According to H. V. Roelse, the accumulation and paying out of unemployment funds would have little if any effect on business fluctuations. Any effect it would have would most likely be in the direction of stability rather than toward accentuation of the business cycle. (Berridge, 1938) As one can see from Table 3, there were definite signs of a down swing in 1938. Eccles claimed this down turn was caused in

part by the implementation of the Social Security Act, and Roelse claimed the act should cause the economy to 'be more stable. The elements in this debate will be pursued further.

Table 3.

Selected Economic Indicators Compared with Social Security Contributions
United States, 1936-1939

	1936	1937	1938	1939
National Income (\$ millions)	65,165	71,172	63,610	69,378
Nat'l Income (1929=100)	78.6	85.9	76.7	83.7
Production (1935-39=100)	103	113	88	108
Employees (thousands)	31,858	33,768	31,239	32,419
SS Contributions (\$millions)	299	950	1,119	1,196

Statistical Abstract of the United States, 1940

Looking to the long-run effects of the act, Dulles said that while the old age benefits would maintain their level in times of deflation, at the same time the taxes for this program decrease. "There is some reason to think it will be a healthy and constructive influence in booms and depressions." (Berridge, 1938) It might be pointed out here that there are two reserve funds in the Social Security Act--one for old-age benefits and one for unemployment. They are financed in similar ways and the payments fluctuate in similar ways, although the fluctuations for unemployment compensation may fluctuate a little more from good times to bad, since unemployment is usually more prevalent in bad times than good. In the meantime, it is valid to refer to their effects interchangeably as has been done with Roelse and Dulles.

According to Gerhard Colm, social security provides an important anticyclical device. As the economy turns downward, benefits automatically increase and contributions decrease. The system thus creates a floor which keeps the economy from dropping to the depths it would reach in the absence of the system. (Colm, 1947) This effect has been noted in the current economic downturn. More people are retiring early and drawing social security at age 62 than would do so normally, and fewer people are delaying drawing security beyond full retirement age. (msnbc, 2009)

For optimum effectiveness as a stabilizer, social security payments should be increased in times of deflation, and decreased in times of inflation. This is actually what happens to the real income level of these payments during these times, so the pressure from groups of beneficiaries is to increase the payments in times of inflation. This gives social security expenditures the tendency to move upward only, and to accentuate the cycle. (Millikan, 1953) This tendency can be seen in 2009 when the cost of living increase for social security payments should have been negative because of deflation, but was pegged at zero (the law does not allow for decreases). Because of political pressure from senior voters, the Obama administration and Congress decided to distribute \$250 to each recipient to compensate for the lack of an increase. (Bloomberg, 2009) The next year, however, the Senate voted against the proposal. (*Blade*, 2010)

The Effects of the Reserve Fund

Although in its initial incarnation, Social Security was intended to operate on pay-as-you-go basis, the intent was to have a trust fund with significant reserves. Money paid in taxes would be kept in the fund and used to pay future benefits. This approach had to be abandoned in the 1950s and 1960s with the sharp increase in claimants, benefits, and life expectancy. Taxes are now used to pay current beneficiaries with a limited trust fund invested entirely in U.S. government bonds. It is interesting, however, from a historical perspective, to look at some of the debate with regard to the reserve fund.

We shall look at the debate on three main topics: the effects of the reserve fund on income distribution, on inflation and deflation, and on investment. This topic was regarded with considerable interest by the writers of the time. The law required the reserve fund to be invested in government bonds only. This led to considerable speculation as to what would happen as the government bought and sold bonds on the market, particularly in relation to the state of the economy at the time the bond transactions took place. The views were widely divergent on this point; and as was stated before, it is unfortunate that this debate took place after the passage of the bill rather than before. If it had taken place before, the writers of the bill could have taken the points more into consideration when the bill was formulated.

In one writer's opinion, social security, by the nature of the reserve fund, will tend to redistribute income from the lower to the higher income groups. Lower income groups will be forced to save. Their money will be used to buy privately held bonds which puts the money in the hands of the wealthy investors. If it is not invested, the money is spent on luxury items. This will be the case because outgo will not match income until 1965, and this is where the excess goes. Thus, the effect is the opposite of the intended redistribution effect. It will be this way as long as the system is kept on an actuarial basis. (Stewart, 1937) Of course, it was not kept on an actuarial basis and the system was later changed to a tax and entitlement system. In boom times interest rates are held down by the excess of investment money caused by the retiring of the federal debt. This accentuates the boom. This assumed, of course, that the federal government would have a surplus in good times, an assumption which did not prove to be true.

In times of depression, bonds are sold in the market to finance the deficit, and because of the large amount involved, counteracts the open-market operations of the Federal Reserve Board. This adds another element of instability to the already depressed economy. A way to make the reserve fund a counter-cyclical device would be to either deposit the money in the Federal Reserve Banks or to buy the bonds from the Federal Reserve. Money would thus be withdrawn in boom times and recirculated in depression times. Even greater economic balance could be achieved by depositing part of the funds in ordinary savings banks, protecting against dampening a boom too soon. But neither measure was permitted under the act. (Stewart, 1937)

Inflation and Deflation

There were fears also of the reserve fund having inflationary influences. These fears grew out of the possibility that the fund would be used to retire debt held by private investors. This assumes that much of the newly released funds will be used for investment and expanded production to the point where inflation occurs. In arguing against the possibility of inflation, Parker bases his argument on the assumption that inflation generally follows a period of unbalanced federal budgets. He goes on to show that the existence of the reserve fund will make for a smaller total federal debt in both a time of deficits and of surpluses, and thus inflation will be less likely to occur. The social security taxes should tend to be deflationary in the short run. The money that is diverted from current consumption is eventually returned to the consumer, balancing the ledger in the long run. (Parker, 1942)

Basing the system on the contributory principle does not mean that all funds should come from that source, assuming that source *is* deflationary to some degree. Only in times of full employment should direct contributions be allowed to approach benefits. When benefits increase as the economy moves away from full employment, the necessary funds should be obtained from other less deflationary sources through general revenue. (Eliot, 1947)

Effect on Investment

The reserve fund, according to George A. Renard, will buy up government bonds, removing a large portion of these tax-exempt securities from the private investment market. These released funds will have to go elsewhere, and thus private investment will be stimulated. (NY Times, 1935) The effect on

investment, however, of the liquidation of unemployment insurance reserves depends on the methods used. In general, it will not have a depressing effect on investment. Firstly, because the amount to be liquidated at any one time is not too great, contrary to what Stewart says, and secondly, when liquidation is necessary, there is likely to be a greater demand for government bonds. It has been seen from experience that in such times, private business will have a desire for liquidity preference. (Berridge, 1938)

Commenting on the sale of bonds, Eleanor Dulles said in the first few years, the income under the program would be greater than the outgo. This would allow the government to retire part of the federal debt and release funds for private investment. Continuing her discussion, she said the act is primarily a savings program, but the government use of these savings is confined to a monetary influence. There is no control over the use of these savings in either the factor or consumer goods market. It depends on how the government influences the money market and where private industry chooses to invest the funds. There is the possibility of government enterprise, but this is regarded as a purely theoretical possibility. (Berridge, 1938)

In the same discussion, Edison Bowers said the government may use the reserve to meet current expenditures and avoid raising current taxes, while increasing the federal debt. (This is, in fact, what has happened.) Investment may be encouraged and facilitated by the avoiding of taxes; but, may be hindered by the rising debt. If the funds are used by the government for investment, investment will increase, unless the government action discourages private investment. Properly timed, government investment may stimulate private investment. (Berridge, 1938) Although such a conclusion does not seem strange to us today, Bowers arrives at his conclusion primarily through intuition, and does not handle it well.

Stewart interjected a more pessimistic note. Since the reserve fund is to be invested in government securities, the reserve will be used to retire the debt held by investing institutions and individuals. These will then seek other types of investment. But continued investment is dependent upon a continuous expansion of consumer buying power. The payroll tax, however, causes a contraction of buying power and the investment markets would fail to develop. It can only be counteracted by an expansionist monetary policy to keep up buying power. (Stewart, 1937)

According to Roelse, there is a danger that social security in its present form may tend to curtail consumer and business spending. Consumer spending is directly curtailed through the taxes on payrolls. Under a balanced budget situation, which is assumed by the writer, it is unlikely that banks will invest in corporate securities to the extent that the public debt is retired. Therefore, the supply of capital for private investment as a result of the accumulation of social security reserves will at most be increased only to a limited extent. As the funds are paid out of the reserve fund, one result of old-age insurance and death benefits will be a decline in saving in the lower income group. This will make less funds available for investment through insurance companies, savings banks, and other similar channels. (Berridge, 1938)

As can be seen, there are two sides to the argument--those who claim the reserves will help investment, and those who claim investment will be hindered by the reserve funds. In the middle ground is the distinction between short and long run effects. Whether one side was right and the other wrong is a question beyond the scope of this paper.

As we have pointed out in this section, there was much opinion on the topic of the economic effects of the act, although not all of the writers were in agreement by any means. As far as the receipts and payments are concerned, it was generally agreed that the act would have a depressing effect on the economy in the short-run, and a stabilizing effect in the long-run. This is mainly because receipts (to the government) began in 1937, and benefits did not begin until 1942.

As far as the reserve funds were concerned, however, there was much disagreement. The disagreement

revolved around the question of the effects of government bond transactions on the economy. The disagreement arises, however, because each writer makes certain assumptions about factors such as the size of the transactions and proceeds to build his case from there. A little empirical research probably could have cleared up much disagreement. The entire argument was largely moot, however, since social security taxes have been used to support deficit spending and the reserve fund is simply a future claim on tax receipts.

As we have been stated previously, it is unfortunate that this discussion and disagreement took place after the act was passed. If the writers had done their research, and had presented their cases to the Committee on Economic Security which drew up the original bill, some of the undesirable effects the writers saw might have been avoided. As will be seen in the next section, congressional debate might also have been considerably improved by such a move.

THE LEGISLATIVE HISTORY OF THE SOCIAL SECURITY ACT

The formation of the Committee on Economic Security was foreshadowed in the president's Message to Congress on June 8, 1934. (Witte, 1962) His message contained the idea that along with recovery there must be reconstruction; and reconstruction means setting up certain goals. The goal of highest priority is "...the security of the men, women and children of the Nation." One of the three ways to promote the security of each citizen is through a program of social insurance. He stated that such a program would be presented the next winter. One can notice his emphasis on security, which was also characteristic of other writers of the time. He continues in this vein by saying that since one of the duties of the federal government is "to promote the general welfare," it is the duty of the government to provide the security which is the basis for that welfare. Social insurance is one of the means for furthering that security. (Roosevelt, 1938)

In the executive order setting up the Committee on Economic Security, the duties of the committee were set forth as follows:

The committee shall study problems related to the economic security of individuals, and shall report to the President not later than December 1, 1934, its recommendations concerning problems which in its judgment will promote greater economic security. (Witte, 1962)

As the main motivating force behind the bill, the president relied heavily on the need for more economic security to provide a justification for his proposing such a bill. He did not refer to the economic conditions or the possible economic effects in his public statements. Security was the keyword in the depression years, and the keyword in the formation of the social security legislation.

Congressional Debate

Paul Douglas, the senator from Illinois and an economist, summarized the quality of the congressional debate on the bill by saying that the debate on the floor of the House on the bill was not on a very high level. (Douglas, 1936) Very little substantive debate took place, and most of the opposition centered on the form of the bill.

The bill was drafted almost entirely by the counsel of the Committee, Thomas Eliot. There was much criticism in the congressional committee hearings on the draftmanship of the bill, but it had never been done before in this form, he had to please many people, and it was done in a hurry. (Witte, 1962) This last point recalls to mind Homan's criticisms of the New Deal administrators, two in particular. One is the lack of clearly defined guiding principles, and the other is sloppily drafted legislation. (Homan, 1936) These comments are certainly reminiscent of the criticisms of the process of passing health care

legislation by the Obama administration. For example, House Speaker Nancy Pelosi was quoted as saying, "...we have to pass the bill so that you can find out what is in it..." (Pelosi, 2010) On January 17, 1935, President Roosevelt sent a special message to Congress recommending legislation on economic security. He urged immediate action, for supplemental state legislation was also required for some titles in the bill, and forty-four state legislatures were either in session or were soon to be. In his message, he summarized the recommendations of the Committee on Economic Security. (Witte, 1962)

When the program was first presented in the president's message, it was praised by the leaders of both parties in Congress as "sound and conservative." Most of the critics said it did not go far enough. (Witte, 1962) This, however, was about as profound as the debate and discussion ever got.

The following summations of debate were all taken from the Congressional Record (1935). The party and state of each Representative come from the World Almanac and Book of Facts for 1936. (World Almanac, 1936) The attempt has been made in these summaries to include only that debate which has any substantive value. Much opposition to the bill was based on the fact that the bill had several distinct titles and purposes, and these were presented at one time for consideration. Those in opposition wanted the different titles presented separately, since they claimed to favor some and oppose others. Much of the debate time was also taken up with more than the usual banter between congressmen. It seemed as if nearly every congressman wanted to get his glowing approval of the bill on record. (Again, the political process apparently has not changed much since then.) The debate summaries will be divided into three parts--the theoretical, current conditions, and the economic.

Representative Southof, Prog. Wisconsin, decided he would start things off right. He favored the bill because it represented "a beginning of a new era for the less fortunate and the under privileged. It is a splendid forward step in the march of progress, in social security." Representative Ford, D. Mississippi, displayed a greater knowledge of the theoretical aspects of social insurance. He stated that "it is a duty of humane civilized government to care for those citizens who have spent a lifetime in promoting their country by being good citizens." The bill "will guarantee our aged citizens relief from the mental and physical torture of poverty in old age." This bill would remove a vast amount of economic uncertainty in old age which the majority of the people are not able to control.

Stephen M. Young, representing Ohio in the House, continued this emphasis on the duty of the government to provide social insurance. His contention was that "the need for old-age security legislation is largely due to the congestion and intensity of modern industrial processes." The needy aged must turn to either government or private charity. It is the duty of the government to provide relief for the needy aged. These people have earned the right to live out their remaining years in relative security. In his argument, one can again see the argument that a person earns the right to old-age security through having contributed to the nation's productivity. In contrast, the current healthcare legislation will cause a redistribution of benefits from the older, retired population to the younger population. (Adamy, 2010) The implications of this feature are still unfolding.

Representative David J. Lewis, D. Maryland, went one step further by feeling that the federal government owed to the workers the right to make a living; and if this right were to be taken from them, they deserved to be compensated. Representative Truax, D. Ohio, summarized the feelings of those basing their arguments on the theoretical aspect by identifying the act as "a milestone in the battle for human rights."

Then there were those whose arguments had their roots in the prevailing economic conditions. Harry I. Harriman, President of the United States Chamber of Commerce, appealed to Congress to defeat the bill on the grounds that the time was not ripe for action. Consideration of the bill should be postponed until business conditions had improved. Proponents of the bill refuted this argument by saying that when prosperity had returned, the driving force of public sentiment would have faded and no action would be

taken at all. (Douglas, 1936) These arguments are, again, reminiscent of arguments for and against the current healthcare legislation.

Returning to the Congressional scene, Representative Thomas H. Cullen, D. New York, considered the bill as promoting both recovery and reform. It included steps to shake off the lingering remnants of the depression and to safeguard against suffering in future depressions. He made these assertions as flat statements, with no rationale for having arrived at such conclusions. On the other hand, Representative Harold Knutson, R. Minnesota, opposed the bill because it was a bill of social reform while the pressing need was for recovery legislation. Although he was sympathetic toward social reform, he felt nothing must be allowed to impede business recovery. Had the arguments presented in section three been available at the time the bill was being considered, arguments such as those just presented might have taken on more meaning, and the topic could have been more deeply explored instead of just being mentioned in passing, and having no real effect on the consideration of the bill. Committee hearings might have also been devoted more to these aspects of the bill rather than to the structure of the bill.

In all the searching done through Congressional Records, only one spark of really meaningful discussion on the economic effects of the bill was found. This was provided by Rep. Samuel B. Hill, D. Washington. Even this small amount had to be brought out under the questioning of Rep. William Sirovich, D. New York. Representative Hill expressed the belief that the purchase of privately held bonds with reserve funds would force this money into investment and thus help commerce and industry. If it were not invested, it would then be liable to income taxes.

Representative Allen T. Treadway, R. Mass., gave several arguments against parts of the bill which contain traces of sound economic reasoning. He approved of Titles I, IV, V, and VI of the bill granting aid to the states for old age pensions, care of dependent children, maternal and child welfare, and public health. He opposed Titles II, VIII, III, and IX dealing with old-age insurance and unemployment on the grounds that they were not emergency measures. They would be a short-run drag on the economy and would not become effective in time to speed recovery. In other words, they were not recovery measures.

He then expanded on his arguments. The unemployment aspects of the bill would cause more unemployment because employers would cut back on workers in order to maintain costs. Secondly, it would put a millstone around the neck of business which was trying to stage a recovery. He was not too specific concerning the makeup of this millstone. "The six percent tax would undoubtedly force many businesses out of business. This would mean more unemployment. In other words, the act would retard recovery rather than help it. The effect of reducing the purchasing power of workers \$900 million to \$280 million annually would also be felt by business.

In reference to the old-age titles, Representative Treadway claimed the payroll tax would increase the cost of living in a manner similar to a turnover tax. This cost would be passed on to the consumer. It would also cause employers to cut employment. He attacked the reserve fund on the grounds that by 1970, the cost of the interest would be nearly a billion dollars a year at three percent on a thirty-two billion dollar reserve fund. He merely states this last fact without trying to determine what the effects of such a cost would be. As with many Congressmen of that day, however, as with many of the present day, the cost would be sufficient reason for opposing a measure.

It is most unfortunate that the debate on the bill was not of a more profound and serious nature. Of course, there are those who would claim that Congressional debate is not now and never has been of a profound and serious nature. The main influence, it seems, in initiating the bill was a need for security. This was brought out in the debate in relatively empty phrases echoing the president's words. This is amply illustrated by Senator Harrison who described the bill as follows:

It is not intended as emergency legislation, to cope with an emergency situation, but rather it is designed as a well-rounded program of attack, on principal causes of insecurity which existed prior to the depression and which we may expect to continue in the years to come. (*NY Times*, 1935)

Perhaps one reason for the poor quality of debate is that the congressmen did not realize the significance of the bill they were considering, or perhaps the debate reflected the unusual willingness of Congress at that time to cooperate with the president. Or perhaps the congressmen had been faced with so much legislation of a revolutionary nature in the preceding few years, that a bill of the significance of the Social Security bill did not seem to be greatly out of proportion to them. Whatever the reason for this lack of meaningful debate, many good substantive arguments both for and against the bill went to waste and were never used. One can even say that Congress was not justified in passing a bill of such significance and designed for such a long period of time without studying the arguments which have been presented in the first three sections more carefully. Whether they were justified or not, they passed the bill, and it is with us today.

CONCLUSION

There was no lack of historical precedent in drawing up the bill, for the United States was one of the last major countries to adopt such legislation. And as in the cases of the other countries, the United States law did not improve significantly upon the German model. The drafters of the United States plan also had choices regarding the bases for the plan. As it turned out, it was decided to make the United States program compulsory and contributory. The lack of success of any major voluntary program was probably the deciding factor in making the American program compulsory. The workers may have also been believed to feel that income would be redistributed in their favor with a compulsory program. And despite the simpler administrative requirements connected with a non-contributory plan, the designers of social security probably made their decision for a contributory plan on the basis of the psychological factors explained in the first section. If they had decided to make social security non-contributory, all of the discussion concerning the reserve fund and the effect of the withdrawing of funds on the economy would not have come about in the form it did. There would undoubtedly have been discussion as to where the money was to come from. Such a program probably would have been more beneficial for the economy at the time, since the raising of additional funds could have been postponed until the economy had fully recovered.

Much of the discussion about the reserve fund became moot in the 1950s and 1960s when Social Security switched to a pure tax and entitlement system. Although the so-called reserve fund was retained, it became simply a method of financing the deficit in the federal budget. When Medicare was passed in the 1960s, they retained the tax and entitlement structure of Social Security, but did not bother with the façade of a reserve fund. The current health care reform moves entirely to a non-contributory system with the proposed funding for the entitlements to come from a variety of tax and benefit modifications. The current discussion, as a result, centers on three issues: the social insurance arguments (i.e. it is the government's responsibility to insure that all citizens have adequate health care), the structure of the system (e.g. public option or not), and the cost and financing aspects, including whether or not such a system should be implemented in a recession. All three were issues in the original social security debates, and the level of the debate does not appear to have improved much since the 1930s.

The stated intent at the beginning of the paper was to explain the areas in which a justification for passing the Social Security Act could be found, and to determine if a justification really existed. In terms of the economic conditions the issues were not clear. If the Social Security Act was intended to be a recovery program, it came a little late, unless one wishes to hedge and claim it was intended to promote full recovery. It was, however, more of a reform program than a recovery program. The keyword of the times

was security, and the act was intended to prevent the insecurity which had accompanied the depression. In considering the economic effects, one wonders if the administration was even justified in promoting a reform program of this nature at this time. The initial effect of the act was to withdraw large sums of money from the economy at a time when the upward trend of the economy needed to be encouraged. Business had not recovered fully, and unemployment was high. Placing this additional burden on the economy probably did have something to do with the downturn of 1937-1938, although other factors are also involved (such as the tightening of the money supply by the Federal Reserve). If the program had been passed during World War II, it would have aided the anti-inflationary program by siphoning off some of the excess funds. And it would have been feasible to pass it at that time, contrary to those who claimed the impetus would no longer have been there, for the makeup of Congress had not changed significantly from 1935 to 1943.

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CREATING A LEADERSHIP DEVELOPMENT PROGRAM FOR YOUR UNIVERSITY

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ABSTRACT

A value-added service provided by many universities (both public and private) is the delivery of Leadership Development programs for important stakeholders in their communities. This past year, such a program was developed and delivered at Coastal Carolina University. The purpose of this special session is to share what we learned during the development and delivery phases of this effort and to collect suggestions from colleagues who have developed and delivered similar programs at other institutions and in other communities.

SESSION OVERVIEW

Leadership can be defined as “the process of influencing others to achieve group or organizational goals.” You manage things, you lead people. In the interest of improving organizational performance, much money is spent on leadership development programs to help develop the skills and traits of effective leaders. As educational institutions, colleges and universities are in a unique position: they can be providers of leadership development programs while concurrently being buyers or recipients of such programs.

The leadership of Coastal Carolina University tasked the Office of Human Resources and Equal Opportunity to advance a leadership development program to serve two important audiences: (1) people in leadership roles at the university, and (2) people in leadership roles in local companies. Following a review of similar efforts elsewhere, colleagues in the Wall College of Business and Edwards College of Humanities and Fine Arts at Coastal developed and delivered the following sessions:

1. Overview session on Leadership Development
2. The Heart of the Leader
3. Dealing Effectively with Conflict (and not letting it get to you)!
4. The Art of Leadership
5. Servant Leadership
6. Diversity Training for Leaders
7. Coaching, Guiding, and Evaluating Your Team Members
8. “It’s Not What You Say, It’s How You Say It!”
9. Empower Yourself
10. Go Forth and Multiply

In addition, three social leadership sessions were designed to bring participants together in a relaxed format to promote group cohesiveness, including a golf outing and a retreat to a former rice plantation along the historic low country of South Carolina.

The program was rolled out in Spring 2010 with monthly sessions delivered to an initial class of 25 participants equally divided between university and non-university personnel. This roll out method was chosen to allow us to learn more about our audience, delivery format, curricular needs, etc. prior to a more broad-based roll out in the following year (Spring 2011).

The purpose of this special session is to share what we learned during the development and delivery phases of this effort with colleagues from other institutions who may be asked to undertake similar efforts on their campuses. And, we welcome others who have developed and delivered such programs to share their lessons with us.

A PRELIMINARY ANALYSIS OF THE NURSING PROBLEM IN RURAL NORTH CAROLINA

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ABSTRACT

The nursing problem in the state of North Carolina is getting progressively worse. This study is an initial attempt to understand the problem using neural network modeling. The findings are reported along with the need for additional data collection and analysis.

INTRODUCTION

There is a nationwide shortage of nurses in the United States. For the state of North Carolina, the rural parts of the state have been experiencing significant declines in the nursing population. A 2008 study conducted by Appalachian State University in collaboration with NWAHEC conducted some focus groups and analyzed data to study the issue. The areas of interest included economic, structural, psychological, work fulfillment, value congruence, and job satisfaction. The study analyzed the attraction and retention of nurses using techniques like structural equation modeling, cluster analysis, and perceptual maps. The study laid the groundwork for identifying variables that impact attraction and retention. The study, however, did not study the extent of impact of each variable and did not present a modeling framework that could assist decision makers in realizing specific outcomes. This paper attempts to address these issues.

The Neural Network Approach

Neural networks are a well-established statistical technique in the literature. Its modeling and predictive ability has often been touted as superior to conventional statistical approaches [3] [4] [5]. To facilitate the modeling process, Predict software produced by NeuralWare, Inc. was chosen [5]. The software has a wizard to facilitate the data classification process. Once the input and output variables have been identified, the wizard allocates one neuron per input and attempts to create a neural network using a training and testing phase. A portion of the data is kept aside for testing. During the training phase, both the input variables and the desired values of output variables are presented to the neural network. A trained network is tested by asking the neural network to predict the output value for a given set of input variables.

Data Used for Analysis

There were 105 variables in the dataset, and 1,046 responses. Out of the responses only 677 were complete with no missing values. 175 responses were missing one value, 52 were missing two values, 13 were missing 3 values, 7 were missing 4 values, and 122 were missing 5 or more values. For the purposes of this study only the 677 complete responses on 105 variables were used. A listing of all the variables used is contained in Figures 1(a), 1(b), and 1(c). Most of the data, with notable exception of demographics data (e.g. age group, gender, etc.) consists of user responses on a 7 point Likert scale, with 1 denoting strong disagreement, 7 denoting strong agreement.

The Modeling Process Used

Since the basic premise of the paper is to analyze the nursing problem in rural North Carolina, the focus of the study is on variables associated with the problem. There are 11 variables that fall into this category in the data set. The first one is Years, the number of years on the job, the second thru fifth variables are BIJobs1-4, related to looking for other jobs, and Prof1-6, related to changing the profession.

In order to analyze the data, four different input-output variable combinations were attempted:

1. OUPUT: Years INPUT: All remaining except BIJobs1-4 & BIProf1-6 (Figure 2)
2. OUTPUT: BIJob1-4 INPUT: All remaining except Years & BIProf1-6 (Figure 3)

3. OUTPUT: BIPProf1-6 INPUT: All remaining except Years & BIJobs1-4 (Figure 4)
4. OUTPUT: Years INPUT: All remaining (Figure 5)

The modeling results are presented in two parts. The first part depicts the results of the training and testing process employed. Several terms are introduced in the first part. A brief description of the same is as follows:

R: Linear correlation between the actual output and the model output.

Net-R: Linear correlation between the actual output and the raw neural net output.

Avg. Abs.: Average absolute error between the actual output and the model output.

RMS: Root mean square error between the actual output and the model output.

Accuracy Measure: Fraction of model output that are within 20% of actual output.

(CI) Confidence Limits: Predicted values are within this distance of target values with 95% confidence.

The second part of the analysis contains two key outputs “average” and “contribution”. The average term is derived by doing a sensitivity analysis on the basic model. The contribution term determines the how the output is influenced by the variable listed on a 100 point scale.

Sensitivity analysis in a Predict model helps us determine the effect of small changes in an input value on the price. This can be quite insightful. To facilitate analysis, it also ranks the input fields according to this sensitivity. Mathematically, sensitivity analysis is a basically a matrix of partial derivatives of output variable with respect to input variables. Sensitivity analysis has the potential of providing good modeling insights. If the input values can be controlled, sensitivity analysis shows which fields should be changed and in which direction to achieve the desired output. A positive mean value implies that increasing the input value will increase the output by the mean value (on average), and vice versa. It is Important to note that highly sensitive fields may not necessarily be important fields for an application.

To study the sensitivity of an input variable with respect to the output variable, the input variable’s value is altered while keeping all other inputs constant and the change in price is noted. This procedure is used on all variables, for all observations, for all models.

To gauge the contribution of each variable towards the output variable, the Predict software performs a contribution analysis. To implement it, the model is run in standard mode for the current record. For each non-missing field in turn, its value is replaced by the mid-range value and a modified output is calculated. The absolute difference between the original neural net output and the modified neural net output is calculated for each non-missing field. This is referred to as the "delta" for the non-missing field. The delta is scaled on a 100 point scale.

Results and Discussion

The preliminary analysis was able to identify the key variables that contribute to determining the output variable value in each of the four models. For instance age-group and degree appear to be the key drivers of longevity in the nursing profession. Job satisfaction, stress, and workloads appears to be key drivers that lead nurses to seek other nursing jobs or drop out of the profession altogether.

Given the large number of variables in the analysis, factor analysis may be helpful in reducing the number of variables. In addition, it may helpful to try more input-output combinations to extract additional information that can permit more intensive modeling. For instance, one could explore the factors that result in seeking other jobs in the same profession, which in presence of high workload stress, younger age, high commuting distances, etc. may lead to leaving the profession altogether.

A significant portion of the data was passed over due to missing values. Given the large number of variables, even with a few missing values, the cut-off data may alter the significant variables and their contributions in some or all of the models attempted. It would be advisable to test the veracity of this argument using at least one model.

Admin1	I like my work schedule
Admin2	I have a reasonable amount of control over my work schedule
Admin3	I enjoy a great deal of flexibility in my work schedule at my facility
Admin4	Management really seems to care about patient welfare at my facility
Admin5	Management really seems to care about the welfare of the nurses
Admin6	My superiors listen to me
Admin7	My supervisors know what they are doing
AgeGroup	Please indicate your age group
Altruism1	I deeply feel a calling to be a nurse
Altruism2	I believe most of my colleagues feel a calling to be a nurse
Altruism3	I became a nurse to help others
Altruism4	I enjoy caring for my patients
BIJob1	I want to switch to another nursing job as soon as possible
BIJob2	I am considering changing my nursing jobs
BIJob3	I am keeping my eyes open for another job opportunity in nursing
BIJob4	I would like to find another nursing employer
BIProf1	I am considering leaving nursing to begin another profession
BIProf2	I want to leave the nursing profession as soon as possible
BIProf3	I am thinking about changing professions
BIProf4	If I had it to do over again, I would still go into nursing
BIProf5	I tell young people that nursing is a great career
BIProf6	I plan to continue in nursing for the rest of my working life
BIRural1	I plan to take a job in a rural environment
BIRural2	I prefer to work in a rural setting
BIRural3	I see myself working in a rural nursing environment
BIRural4	I am attracted to the rural lifestyle
BIUrban1	I plan to take a job in a urban environment
BIUrban2	I prefer to work in a urban setting
BIUrban3	I see myself working in a urban nursing environment
BIUrban4	I am attracted to the urban lifestyle
Degree	Please indicate your terminal nursing degree
Eco1	Nursing is a well paying profession
Eco2	I am well compensated for what I do
Eco3	Nursing pays better than most of the other career choices readily available to me
Eco4	I am satisfied with my current salary as a nurse

Figure 1 (a): Survey Fields for the Study

Facility1	Our health care facility is state of the art
Facility2	We employ the latest and most up-to-date technologies to care for our patients
Facility3	We employ the best practices to care for our patients
Facility4	My physical surroundings at work are pleasant
Fulfill1	I am regularly able to perform a variety of tasks in my job
Fulfill2	As a nurse, I am usually able to complete the whole task from beginning to end
Fulfill3	In nursing, I feel my day-to-day tasks are meaningful
Gender	Please indicate your gender.
Geo1	Geographic location is more important to me than pay
Geo2	I am bound to my current location by family/spousal issues
Geo3	Location is one of the most important issues in my decision to take a particular job
Geo4	Living close to my extended family and friends is very important to me
Geo5	The small quiet life of a rural environment is more inviting to me than that of a larger city
Geo6	I prefer to have the cultural and social options provided by a larger city
Geo7	I prefer to work in a rural hospital over an urban one
Geo8	I believe it is better for my career to work in an urban hospital
Group1	I feel at home in my nursing unit
Group2	I have many friends at work
Group3	There is a lot of teamwork between nurses and doctors in my unit
Group4	The people I work with take a personal interest in me
HomeComm	Response
HomeZip	Open-Ended Response
ITEcon1	Technology investments are costing money that could otherwise go to my salary
ITEcon2	The need for computer system investments are making it hard to keep up with other expenses
ITEcon3	The investment in new computer systems is not worth the cost
ITEcon4	Computer systems boost productivity in our hospital
ITPsych1	I find computer systems stressful
ITPsych2	I don't understand computer technology
ITPsych3	Computers are more trouble than they are worth
ITPsych4	I don't like computer charting
ITSat1	I prefer to work in an organization with modern computer equipment
ITSat2	Information technology makes my job easier
ITSat3	I like to keep my skills on computer systems current
ITSat4	I enjoy using work computers

Figure 1(b): Survey Fields for the Study

ITStruct1	Our computer systems at work add more work to my day
ITStruct2	Our computer systems at work are easy to use
ITStruct3	Our computer systems at work are well designed
ITStruct4	Our computer systems at work help me do my job better
ITStruct5	Our computer systems at work are compatible with one another
ITStruct6	Our computer systems take me away from my patients
JobSat1	I am satisfied with my current job
JobSat2	I am satisfied with the nursing profession
JobSat3	I would recommend becoming a nurse to others
JobSat4	If I had it to do over again, I would still become a nurse
JobSat5	I love being a nurse
Legal1	I am concerned about personal lawsuits
Legal2	Legal regulations make it hard to do my work
Stress1	I have too much work to do and too little time to do it
Stress2	My job gets to me
Stress3	My job is stressful
Stress4	I am in danger of becoming burned out
Stress5	My job leaves me emotionally exhausted
Stress6	Work stress is affecting my home life
Trust1	I trust my colleagues
Trust2	I trust management
Trust3	I trust our healthcare system
VC1	My employer's values align very closely with my personal values
VC2	Those above me in the organization put quality care of the patient first
VC3	My company and I agree on patient care
VC4	I strongly believe in the mission and vision of my organization
VC5	My organization and I rarely see things differently
VC6	My organization and I agree on environmental issues
WorkComm	Response
Workload1	I generally have enough time to get my job done
Workload2	I have sufficient time to give my patients the direct patient care they deserve
Workload3	Given our acuity levels, we generally have good nurse / patient ratios at my facility
WorkZip	Open-Ended Response
Years	Please tell us how many years you have been a nurse.

Figure 1(c): Survey Fields for the Study

NEURAL NETWORK MODELING RESULTS (1)

Model Output Variable(s): YEARS

Model Input Variables(s): Rest all, except BIPros1-6 and BIJob1-4

Years	R	Net-R	Avg. Abs.	Max. Abs.	RMS	Accuracy	CI	Records
Train	0.7893	-0.7897	5.2065	24.1297	6.6730	0.8985	13.0114	473
Test	0.7573	-0.7615	5.6084	22.4364	7.0605	0.8725	13.8236	204

Variable	Average	Contribution
AgeGroup	0.7105	67
Degree	0.1543	20
BIRural1	-0.0321	1
Gender	-0.1172	2
Eco2	0.0728	7
JobSat3	-0.0463	3
ITPsych3	-0.0398	0

Figure 2: Modeling Results using YEARS as Output Variable with 10 BI Variables Removed

NEURAL NETWORK MODELING RESULTS (2)

Model Output Variable(s): BIJobs1, BIJobs2, BIJobs3, BIJobs4

Model Input Variables(s): Rest all, except YEARS and BIProfs1-6

BIJob1	R	Net-R	Avg. Abs.	Max. Abs.	RMS	Accuracy	CI	Records
Train	0.5471	0.5633	0.7838	6.6038	1.1453	0.8732	2.2331	473
Test	0.4938	0.4709	1.1262	5.5025	1.4443	0.6765	2.8278	204
BIJob2	R	Net-R	Avg. Abs.	Max. Abs.	RMS	Accuracy	CI	Records
Train	0.5176	-0.5238	0.9591	5.8118	1.3209	0.7907	2.5756	473
Test	0.5036	-0.4815	1.1055	4.2061	1.4151	0.6863	2.7705	204
BIJob3	R	Net-R	Avg. Abs.	Max. Abs.	RMS	Accuracy	CI	Records
Train	0.5153	-0.5193	1.1714	4.4656	1.4844	0.6512	2.8943	473
Test	0.3144	-0.3137	1.2137	4.4229	1.5473	0.6275	3.0295	204
BIJob4	R	Net-R	Avg. Abs.	Max. Abs.	RMS	Accuracy	CI	Records
Train	0.5890	-0.5981	0.8051	5.6354	1.0989	0.8626	2.1428	473
Test	0.4850	-0.4662	1.1248	4.7934	1.4449	0.6912	2.8288	204

Variable	Average	Contribution
JobSat1	0.29	37
Stress4	0.13	27
JobSat4	0.11	15
VC4	0.17	9
Admin6	0.07	9
Facility2	0.1	7
Group2	0.07	7
ITStruct1	0.09	7
Fulfill1	0.04	6
Stress6	0.06	6
Stress3	0.09	6
BIUrban1	0.12	6
AgeGroup	0.05	5
JobSat3	0.02	5
Legal2	0.06	1
Facility4	0	1
BIRural1	0.07	0
Fulfill2	0.03	0
ITSat2	0.11	0
ITStruc5	0.01	0
Stress2	0.02	0

Figure 3: Modeling Results using BIJobs1-4 as Output Variables

NEURAL NETWORK MODELING RESULTS (3)

Model Output Variable(s): BIProf1, BIProf2, BIProf3, BIProf4, BIProf5, BIProf6

Model Input Variables(s): Rest all, except YEARS and BIJob1-4

BIProf1	R	Net-R	Avg. Abs.	Max. Abs.	RMS	Accuracy	CI	Records
Train	0.6983	0.6873	0.9230	6.4030	1.3069	0.7949	2.5483	473
Test	0.3142	0.3020	1.0357	6.9080	1.4573	0.7990	2.8531	204
BIProf2	R	Net-R	Avg. Abs.	Max. Abs.	RMS	Accuracy	CI	Records
Train	0.7436	0.7405	0.6666	5.6750	1.0169	0.8964	1.9828	473
Test	0.4467	0.4546	0.7738	6.9894	1.0803	0.8284	2.1152	204
BIProf3	R	Net-R	Avg. Abs.	Max. Abs.	RMS	Accuracy	CI	Records
Train	0.6725	0.6665	1.0236	6.6781	1.3662	0.7336	2.6640	473
Test	0.3575	0.3540	1.0793	6.0775	1.5099	0.7549	2.9561	204
BIProf4	R	Net-R	Avg. Abs.	Max. Abs.	RMS	Accuracy	CI	Records
Train	0.9260	0.9223	0.4403	2.3731	0.6257	0.9556	1.2200	473
Test	0.7933	0.8055	0.4171	4.2355	0.6421	0.9559	1.2571	204
BIProf5	R	Net-R	Avg. Abs.	Max. Abs.	RMS	Accuracy	CI	Records
Train	0.8975	-0.8917	0.4878	2.5963	0.6634	0.9429	1.2936	473
Test	0.7513	-0.7478	0.4752	1.6800	0.6189	0.9461	1.2117	204
BIProf6	R	Net-R	Avg. Abs.	Max. Abs.	RMS	Accuracy	CI	Records
Train	0.6968	0.6924	0.7488	5.8022	1.1115	0.8668	2.1673	473
Test	0.6746	0.6758	0.5737	2.2965	0.7652	0.9216	1.4981	204

Variable	Average	Contribution
JobSat4	0.20	30
JobSat5	0.10	13
BIJob2	0.13	5
Stress3	0.02	4
JobSat2	0.08	3
Workload2	0.00	2
BIUrban4	0.03	2
Eco3	0.04	1

Figure 4: Modeling Results using BIJobs1-4 as Output Variables

NEURAL NETWORK MODELING RESULTS (4)

Model Output Variable(s): YEARS

Model Input Variables(s): Rest all

Years	R	Net-R	Avg. Abs.	Max. Abs.	RMS	Accuracy	CI	Records
Train	0.8042	-0.8052	5.0635	27.5252	6.4516	0.9027	12.5796	473
Test	0.7579	-0.7607	5.6059	22.4482	7.0596	0.8431	13.8218	204

Variable	Average	Contribution
AgeGroup	0.68	66
Degree	0.16	12
ITPsych2	0.12	9
WorkComm	0.04	7
VC2	0.06	4
JobSat5	-0.07	4
BIProf4	-0.07	2
JobSat1	0.09	2
Gender	-0.08	2
Stress3	-0.03	1
Fulfill1	0.05	1
ITStruct4	0.04	1
BIJob1	-0.04	1

Figure 5: Modeling Results using YEARS as Output Variable and All the Rest as Input

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STUDENTS' ATTITUDES TOWARDS BUSINESS CODES OF ETHICS: THE IMPACT OF GENDER

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ABSTRACT

This paper extends previous research by investigating the basis for attitudes toward codes of business ethics. Specifically, its purposes are twofold. First, to examine students' attitudes with regard to codes of ethics. Second, to ascertain whether differences do exist between the genders with respect to these attitudes.

A total of 853 students enrolled in seven universities in the northeastern and southeastern United States participated in the study. The analysis of the data was conducted in several stages. A multivariate analysis of variance (MANOVA) was performed where the students' gender constituted the two levels of the independent variable and their scores on eight items were the dependent variables. The MANOVA revealed that overall there were significant differences between the genders. To understand the underlying contributions of the variables to the significant multivariate effect, each of the eight dependent variables was tested using a one-way analysis of variance (ANOVA) with the two groups treated as our two levels of the independent variable.

The results revealed significant differences between the two samples. Overall, the female students were more sanguine about the efficacy of codes of business ethics. Limited generalizations and important implications are discussed.

INTRODUCTION

The ethical standards and attitudes of managers and business students have been among the principal issues confronting business and society for many years. Of particular interest to educators, practitioners, and regulators is the extent to which corporations are responsive to the expectations of shareholders and society. While businesses have always been responsible for maximizing long-term value for the shareholders, they are increasingly expected to recognize the importance of their responsibilities toward society and to faithfully adhere to certain ethical standards.

The effects of individual and organizational factors on business ethics have received much attention in the literature. This is mostly motivated by concern over the public's declining positive attitudes about the ethical values and integrity of current and future managers and business executives. Visible indicators of problematic leadership eventually surface in the form of corporate crises such as bankruptcy, executive turnover, legal difficulties, ethical failings, and hostile relations with various stakeholders.

In recent years, widespread media accounts of outbreaks of ethical failings and questionable or abusive practices by corporations have prompted fresh concern over the societal impact of corporate activities and the extent to which managers are responsive to society's expectations. Not surprisingly, these revelations and criticisms have fostered considerable interest and scholarly work in the ethics area.

LITERATURE REVIEW

Codes of Ethics

Several organizational variables help shape ethical behavior. Some companies legitimize the

consideration of ethics as an integral part of decision making by providing strong guidance and continuously reminding managers of what is ethical. Codes of ethics are an increasingly popular tool. Businesses rely on them to reduce ambiguity, promote ethical practices, and establish a strong ethical environment. These are formal documents, expressed in language anyone can understand, that state an organization's primary values and the ethical rules and principles employees are expected to adhere to (see, e.g., Adams et al., 2001; Farrell and Farrell, 1998; Valentine and Barnett, 2002, 2003). They are "moral standards used to guide employee or corporate behavior" (Schwartz, 2001, p. 248). Kaptein (2004) shows that among the two hundred largest corporations in the world, 52.5 percent have adopted some type of code of ethics. Codes of ethics are particularly helpful when an individual's self-interest is incompatible with acting in accordance with his or her ethical standards.

It must be remembered that codes of ethics have limits because they cannot anticipate every situation that may arise. Also, in some cases, they are principally public relations statements. Their effectiveness depends heavily on whether they are current and robust, whether they are strictly implemented, and how employees who break the codes are treated. Most importantly, they require management's genuine commitment and their explicit and unequivocal support. The Enron corporation "while continuing to use three different sets of accounts, ...also gave its four-page ethical codes to all new employees to sign on their first day" (Hemingway and Maclagan, 2004, p. 35). A number of writers have shown that codes of ethics may be used to provide organizations with legitimacy (e.g., Boiral, 2003; Weaver et al., 1999). Indeed, more than three decades ago, Meyer and Rowan (1977) argued that managers may symbolically employ legitimizing structures such as codes of ethics solely to create a positive impression. Suchman (1995) contends that "organizations often put forth cynically self-serving claims of moral propriety and buttress these claims with hollow symbolic gestures..." (p. 579).

Some studies of codes of ethics have focused on specific industries. For example, Montoya and Richard (1994) compared health care facilities and energy companies. Emmelhainz and Adams (1999) targeted firms in the apparel industry, Kolk and van Tulder (2002) surveyed international garment companies, van Tulder and Kolk (2001) concentrated on the sporting goods industry, and Preble and Hoffman (1999) analyzed the franchising industry.

A number of investigations have examined a variety of professions. Gaumnitz and Lere (2002) examined fifteen professional organizations such as the Institute of Internal Auditors and the American Marketing Association. Somers (2001) compared management accountants working in organizations with and without a code of ethics. Pierce and Henry (2000) and Harrington (1996) surveyed information systems professionals, Nwachukwu and Vitell (1997) examined marketing and advertising professionals, and Valentine and Barnett (2002) concentrated on sales organizations.

Other researchers have investigated whether organizations with codes of ethics elicited greater commitment from their professional staff. For example, Valentine and Barnett (2003) report that sales managers employed by companies with a code of ethics exhibit greater commitment toward their organization than those whose companies had not developed such a code. Similarly, Somers (2001) found that accountants' organizational commitment was higher in companies with a code of ethics than was commitment in those that did not have one.

Still others have examined codes of ethics in certain countries. Brytting (1997) surveyed companies in Sweden. Lefebvre and Singh (1996) compared companies in Canada and the U.S. Bondy, Matten, and Moon (2004) compared Canadian, German, and U.K. companies. Boo and Koh (2001) surveyed top and middle-level managers in Singapore. Stohs and Brannick (1999) interviewed managers in Irish owned companies.

Gender

A sizeable academic literature has investigated students' attitudes toward business ethics. The research

has come from many disciplines, and has focused on a wide range of issues. Business leaders and organizational theorists have long recognized the importance of including these prospective leaders and executives in ethics research. Their perceptions may be a harbinger of attitudes in the business community. In their research, Glenn and Van Loo (1993) noted that there were indications that business students were making less ethical choices in the 1980s than in the 1960s. More recently, Webster and Harmon (2002) compared today's college students with college students of the 1960s and found "a continuing societal movement toward Machiavellian behavior" (p. 435).

One important stream of research is in response to calls for the study of a person's demographic characteristics as antecedent variables (e.g., Kelley et al., 1990). As a growing number of women graduate from business schools and rise to managerial and executive levels, the ethics literature has appreciated the value of examining the influence of gender. According to Robin and Babin (1997), gender and age are the two most heavily researched variables in this literature. The purpose of such research is to investigate differences and commonalities of attitudes based on the gender of respondents. Indeed, one of the major criticisms of Kohlberg's (1969, 1984) seminal work on moral development has been that the critical data to empirically validate his model were drawn from an all-male sample.

When gender was included as an independent variable, the results have been inconclusive. Some studies have reported no significant differences between female and male students. Overall, empirical studies of the influence of gender on students' ethics have produced conflicting results. For example, no gender differences were found by Davis and Welton (1991) regarding 17 ethical situations dealing with professional ethics. Similar results were obtained by Tsalikis and Ortiz-Buonafina (1990); Ford and Lowery (1986); Friedman, Robinson, and Friedman (1987); and McCuddy and Peery (1996). Other studies have focused on more homogenous subjects, based on their area of study. For example, Stanga and Turpen's (1991) survey of accounting students found no significant differences between females and males. Similarly, Gilligan and Attanucci's (1988) study of medical students revealed no relationship between gender and moral orientation.

Other studies have reported very different results. Significant differences in ethical judgments of female and male business students have been found by a number of authors. For example, Arlow's (1991) study found that females place greater emphasis on ethical values and social responsibility than males. A study by Church et al. (2005) revealed that gender does influence ethical decisions. Ruegger and King (1992) reported that female students rated behavior as less ethically acceptable than males in 6 of 10 situations. Also, Whipple and Wolf (1991) and Whipple and Swords (1992) concluded that females are more ethical when different business scenarios were presented to them. Galbraith and Stephenson (1993) reported that, when dealing with issues of self-interest, males and females use different decision criteria. Concerning the role of ethics in social and interpersonal relationships, Smith and Oakley (1997) found that females had higher expectations for ethical behaviors which reflect concern for social and interpersonal relationships. In a study of undergraduate business students, males and females offered different perceptions of a just society (Prasad et al., 1998). When Lawson (2004) examined classroom cheating, he concluded that, on average, women held more ethical beliefs than men. Betz, O'Connell, and Shepard (1989) observed that men were more than twice as likely than women to say they would engage in certain actions regarded as less ethical. Khazanchi (1995) concluded that women are better able to recognize unethical actions in information systems than men. Landry et al. (2004) found that female students, compared with the men, had a higher degree of ethical sophistication. The women demonstrated strong responses with respect to situations involving unfairness, injustice, and moral wrongness. Also, Loe and Weeks (2000) found that women demonstrated higher levels of moral development than did the men. Finally, Ameen, Guffey, and McMillan (1996) reported that, among accounting students, females were less tolerant than males of unethical behavior.

While many studies have attempted to determine whether there were differences in ethical attitudes and behavior between female and male students, significant gaps in the literature remain. One area which has

been largely overlooked is whether there are differences with respect to attitudes toward codes of business ethics. The current study attempts to partially fill this void. One important longitudinal study examining business students' attitudes toward ethics codes was conducted by Peppas (2003). He assessed opinions of ethics codes and what their reasonable enforcement would accomplish via an instrument developed by Becker and Fritzsche (1987) to survey managers in Germany, France and the U.S. Peppas' study was conducted in 1998 and 2002 to compare attitudes at two different points in time. The findings indicated that, with one exception, attitudes toward codes of ethics were not significantly different in 2002 from what they were in 1998. That is, they did not change following the highly publicized reports of corporate unethical conduct and scandals. While this study has made important contributions to our understanding of attitudes toward codes of ethics, no attempt was made to examine differences between female and male students in spite of the possible influence of gender on ethical attitudes as reported by other studies. This concern warrants further investigation.

Therefore, this paper extends previous research by taking its point of departure in Peppas' appeal that "the findings of (his) study beg for further research ... to shed light on and to examine the *basis* (italics mine) for attitudes toward codes of ethics..." (p.85). Specifically, its purposes are twofold. First, to examine students' attitudes with regard to codes of ethics. Second, to ascertain whether there is an association between these attitudes and a person's gender.

METHODOLOGY

Data were collected as part of a larger cross-national study of business ethics. A total of 874 graduating undergraduate students from seven universities in the southeastern and northeastern U.S. were surveyed. All were volunteers who were briefed on the importance of the study and told that all the questionnaires were anonymous. Although participation during class time was voluntary, only eighteen students refused to participate in the study. Of the 874 completed questionnaires, twenty-one did not disclose their gender and were, therefore, excluded from the analysis.

Table 1. "Codes of Ethics" Variables

Assume for the moment that an Ethical Practices Code has been drawn up by professional pharmacists in your state. The following statements assess what you think such a code and its reasonable enforcement would accomplish.

1. The code would raise the ethical level of business in this profession
 2. The code would be easy to enforce
 3. In situations of severe competition, the code would reduce unethical practices
 4. Individuals working in this profession would welcome the code
 5. The code would protect inefficient pharmacists
 6. The code would reduce the profitability of pharmacies
 7. The code would help pharmacists by clearly defining the limits of acceptable conduct
 8. People would violate the code whenever they thought they could avoid detection
-

A demographic section gathered data on the respondents' gender, age, and years of work experience. The questionnaire included an additional section designed to assess attitudes toward ethics codes for professional pharmacists. This profession was selected primarily due to its innocuous character, and because it does not tend to elicit negative reactions and is not afflicted by disapproving opinions or attitudes. The eight items in this section were inspired by the research of Becker and Fritzsche (1987) and Peppas (2003). Respondents were asked to assume that an Ethical Practices Code had been developed for professional pharmacists. Then they were requested to indicate on a five-point Likert scale (1= Strongly

Disagree, 5 = Strongly Agree) the extent to which they disagreed or agreed with eight statements relating to the possible consequences of such a code in this profession.

Table 1 shows the eight statements. To evaluate the clarity of the instructions and items, the questionnaire was pilot tested on a group comprised of graduate students in a research methods class. Several minor problems in the format and wording of the items were found and changes and refinements were made accordingly. The eight items were treated as the dependent variables in the analysis, while gender constituted the independent variable.

RESULTS

Fifty-five percent of the students were male. The average age was 25 years. Overall, they had 4.7 years of work experience. Two *t*-tests showed no significant differences between the genders with respect to age and years of work experience, respectively. The average scores and their standard deviations from the entire sample for the eight items are displayed in Table 2.

The analysis of the results was conducted in several stages. Since, as shown in Table 3, the means of the two groups' scores on each of the items are different, a multivariate analysis of variance (MANOVA) procedure was considered to be the most appropriate analytic technique for exploring differences in scores between the genders. This procedure compensates for variable intercorrelation and provides an omnibus test of any multivariate effect. However, as a preliminary check for robustness, a test for unequal variances between the two groups was conducted. Box's *M* test for homogeneity of dispersion matrices produced a nonsignificant *F* ($p = .39$). This confirmed the homogeneity of the two variance-covariance matrices thus validating the appropriateness of the use of the MANOVA for the analysis. The MANOVA revealed significant differences between the two groups. That is, overall, the two groups provided different responses.

Finally, to understand the underlying contributions of the variables to the significant multivariate effect, each of the eight dependent variables was tested using a one-way analysis of variance (ANOVA) with the two groups treated as our two levels of the independent variable. The results, depicted in Table 3, show that differences between the two groups were significant on seven of the eight variables.

Table 2. Means and Standard Deviations for the Entire Sample

	Mean	s.d.
1. The code would raise the ethical level of business in this profession	3.04	1.15
2. The code would be easy to enforce	3.03	0.85
3. In situations of severe competition, the code would reduce unethical practices	2.88	1.03
4. Individuals working in this profession would welcome the code	4.46	1.37
5. The code would protect inefficient pharmacists	3.33	1.18
6. The code would reduce the profitability of pharmacies	3.36	1.36
7. The code would help pharmacists by clearly defining the limits of acceptable conduct	3.66	1.45
8. People would violate the code whenever they thought they could avoid detection	3.78	1.31

DISCUSSION

Surprisingly little attention has been given to students' perceptions of business codes of ethics. A particularly critical subject concerns similarities and differences between female and male students with respect to these codes. This study led to several insights about this relationship with important implications for practitioners and educators. First, when the results shown in Table 3 are analyzed, several patterns emerge. Overall, the male students felt that the pharmacists would welcome the code (mean = 4.44) and that it would help them "by clearly defining the limits of acceptable conduct" (mean = 3.50); however, many believed these same pharmacists would violate the code whenever they thought they could avoid detection (mean = 3.97). Indeed, their average scores were even lower for "the code would raise the ethical level of business" (mean = 2.96), "the code would be easy to enforce" (mean = 2.87), and "in situations of severe competition, the code would reduce unethical practices" (mean = 2.86). Interestingly, the mean scores for these three items were below the midpoints of the scales. That is, although they believed that the code would be well received by pharmacists and that it would help clarify the limits of acceptable behavior, in their opinion its impact would be modest. Finally, the male students' scores for "the code would protect inefficient pharmacists" and "the code would reduce the profitability of pharmacies" were well above the midpoints of these two scales (means = 3.49 and 3.68, respectively).

The female students felt that the pharmacists would welcome the code (mean = 4.50) and that "the code would help pharmacists by clearly defining the limits of acceptable conduct" (mean = 3.86), but believed that these same pharmacists would violate the code whenever they thought they could avoid detection (mean = 3.55). Their average scores for "the code would raise the ethical level of business" (mean = 3.12), "the code would be easy to enforce" (mean = 3.18), and "in situations of severe competition, the code would reduce unethical practices" (mean = 3.02) were slightly above or slightly below the midpoints of the scales and well below their overall feeling that the pharmacists "would welcome the code" (mean = 4.50). Finally, the females' scores for "the code would protect inefficient pharmacists" and "the code would reduce the profitability of pharmacies" were slightly above the midpoints of these two scales (means = 3.18 and 3.01, respectively).

When the men's scores are compared with those of the female students, the ANOVA results show that, in general, the latter were more positive with respect to the impact of codes of ethics - they were more confident that the code would raise the ethical level of business ($F_{1,851} = 4.07, p = .04$). In addition, the females were more optimistic about the ethical impact of the code "in situations of severe competition" ($F_{1,850} = 5.03, p = .03$) and regarding their perception that "the code would be easy to enforce" ($F_{1,851} = 28.31, p < .00$). Also, the female students were more confident that the code would help pharmacists by clearly defining the limits of acceptable conduct ($F_{1,849} = 13.01, p < .00$). On the other hand, male students were more certain that the code would reduce the profitability of the industry ($F_{1,841} = 51.27, p < .00$), would protect inefficient pharmacies ($F_{1,851} = 14.52, p < .00$), and would be violated whenever pharmacists thought they could avoid detection ($F_{1,851} = 21.69, p < .00$). Finally, no significant differences between the female and male students with regard to the code being welcomed by individuals working in this profession ($F_{1,846} = 0.41, p = .52$).

Taken as a whole, these results corroborate previous research showing that gender has a significant impact on students' attitudes toward business ethics. Overall, the females were more sanguine with respect to the code's influence on the pharmacists' behavior and efficiency, its impact on the profitability of their industry, and the ease of its enforcement. One potential explanation may be found in the literature on the socialization process. Gilligan (1982) and Gilligan and Attanucci (1994), for example, concluded that men and women perceive ethical matters from distinctly different perspectives. They contend that these differences can be attributed to the early socialization process which fosters an "ethic of caring" in women. Nevertheless, both groups agreed that the code would be difficult to enforce and that it would not reduce unethical practices when competition is intense.

Table 3. ANOVA Results for Differences between Female and Male Students ^a

Dependent Variables	Females	Males	F	p
	(n = 384)	(n = 469)		
	Mean	Mean		
The code would raise the ethical level of business in this profession	3.12 (1.19)	2.96 (1.12)	4.07	.04
The code would be easy to enforce	3.18 (1.22)	2.87 (0.80)	28.31	<.00
In situations of severe competition, the code would reduce unethical practices	3.02 (1.02)	2.86 (1.05)	5.03	.03
Individuals working in this profession would welcome the code	4.50 (1.39)	4.44 (1.35)	0.41	.52
The code would protect inefficient pharmacists	3.18 (1.02)	3.49 (1.30)	14.52	<.00
The code would reduce the profitability of pharmacies	3.01 (1.43)	3.68 (1.30)	51.27	<.00
The code would help pharmacists by clearly defining the limits of acceptable conduct	3.86 (1.36)	3.50 (1.52)	13.01	<.00
People would violate the code whenever they thought they could avoid detection	3.55 (1.22)	3.97 (1.38)	21.69	<.00

^a Standard deviations are in parentheses.

In spite of these differences, both groups' scores provide little encouragement and comfort to those who advocate and wish to promote high ethical standards in business. There was general agreement that pharmacists would welcome a code of ethics and that such a code would help clarify the limits of acceptable behavior. Yet both groups expected pharmacists to violate the code when they could evade detection. Furthermore, they did not expect such a code to have much of an impact and felt that it was "bad business".

For business practitioners, these results evoke a greater urgency for the need to advance organizational ethics. Although female students were generally more disposed and sensitive to codes of ethics, this study demonstrates both genders' skepticism regarding their efficacy. Business leaders must recognize that codes of ethics alone are necessary but insufficient. Businesses legitimize the consideration of ethics as an integral part of decision making by providing strong guidance and continuously reminding managers of what is ethical. Some rely exclusively on codes of ethics to reduce ambiguity, promote ethical practices, and establish a strong ethical environment. "Merely having standards is not enough, a company must make the standards understood, and ensure their proper dissemination within the organizational structure" (Palmer and Zakhem, 2001, p. 83). Codes are more effective when they are supported by formalized training programs that promote ethical conduct. According to Valentine and Fleischman (2007), "ethics codes and training signify that the company is institutionalizing an ethical culture by improving individual moral development" (p. 167). Today many businesses and professional societies are setting up seminars and workshops in ethics training. Typically, their code of ethics is used as a guide or standard. The purpose of such training is to sharpen the written ethical code, demonstrate its relevancy, and bring it to life (Valentine and Fleischman, 2008).

These results provide additional momentum to calls for requiring business ethics courses in the business curriculum. There is evidence that these classes do have an impact upon ethical behavior by reinforcing and strengthening the ethical beliefs of some or, for others, calling the inadequacy of their beliefs into question. Although this topic is discussed in depth in separate courses, and often arises in the ordinary course of teaching other business subjects, Albrecht and Sack (2000) report that one of the most frequent criticisms of business curricula and course content is "we do not deal enough with values, ethics, and integrity" (p. 512). The results seem to offer proponents of greater emphasis on societal issues and ethical conduct in business education support for their normative suggestions. For example, Hathaway (1990) contends that business students should be trained in understanding the responsibility of business to its larger social system. Only then can they "become better managers...and lead a corporation or two toward the kind of responsible behavior sorely needed in this troubled world" (p. 61). Indeed, some authors have argued that, if business schools themselves are to act as socially responsible organizations, they have a moral obligation to foster an awareness of the broader implications of business decisions (Gandz and Hayes, 1988).

This study contributes to an improved understanding of differences between female and male managers. However, caveats must be offered regarding the conclusions generated by this research. First, additional research with larger national samples from each group would be necessary to confirm these findings. As Shaub (1994) points out, an individual's ethical perspective could be influenced by geographical and cultural location. Another caveat concerns the generalizability of these results. A study such as this one is based largely on aggregate measures. However, it opens a line of inquiry on whether these results are valid when only those operating in particular industries are surveyed. This would ensure a greater homogeneity within the group being studied. Finally, a comparison of business students and practitioners would be another productive avenue. For example, it would be useful to examine differences between future managers, younger managers, and managers with more extensive work experience. This type of analysis would yield insight into the perceptions of these three generations' attitudes toward codes of ethics.

In conclusion, the findings of this study provide helpful insights into an area of growing concern to society and all types of organizations. The numerous managerial ambiguities that are inherent in business decisions are further complicated by growing societal demands on corporations and increased awareness of the ethical dimension of decision making. This issue is likely to gain increased attention by educators and practitioners in the coming years.

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GROUP ASSOCIATION USING IDENTITY ANALYSIS

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ABSTRACT

Personal identity is an important topic in information systems in general and data analytics in particular. Normally associated with digital security and privacy, the scope of identity is much greater and affects most aspects of everyday life. Related subjects are behavioral tracking, personal-identifiable information (PII), privacy data relevance, data repurposing, identity theft, and homeland security. The purpose of this paper is to establish a context for using analytics to combine evidence to categorize certain subjects based on belief structures.

INTRODUCTION

Identity is a major issue in the security of modern information systems and the privacy of data stored in those systems. Security and privacy concerns are commonly associated with behavioral tracking, personal-identifiable information (PII), the relevance of private data, data repurposing, identity theft, and homeland security. We are going to approach the subject from a data analytic viewpoint, where the primary challenge is to use identity in an effective way to determine group membership. Instead of focusing on the protection of identity in this paper, we are going to propose methods for using identity to make essential judgmental decisions.

Identity Concepts

Identity is a means of denoting an entity in a particular namespace and is the basis of security and privacy – regardless if the context is digital identification or non-digital identification. We are going to refer to an identity object as a *subject*. A subject may have several identities and belong to more than one namespace. A pure identity denotation is independent of a specific context, and a federated identity reflects a process that is shared between identity management systems. When one identity management system accepts the certification of another, a phenomenon known as “trust” is established. The execution of trust is often facilitated by a third party that is acknowledged by both parties and serves as the basis of digital identity in computer-based information systems and personal recognition in social affairs. (Salido 2010) There is another side to personal recognition. We are often afforded the identity of a person based on the judgment of a third party and are obligated to respond to that assessment. It would seem to be prudent in a civilized society to obtain additional information on the subject and combine the various items of information to obtain a composite view before engendering a timely response to the situation.

Belief Concepts

Belief is often regarded as a mental state in which a person holds a proposition to be true without necessarily being able to prove its truth to other persons. Even though absolute certainty is not required with belief, a person’s set of beliefs can play an important role in the causation of behavior. Belief is associated with rational behavior and behavior that is not totally rational. Belief has a lot to do with a believer’s mind. If a representation for belief P exists in a person’s mind, then it is an *explicit belief*. If a representation for belief Q does not exist in a person’s mind but is based on another proposition P, then it

is an *implicit* belief. Beliefs that are based on an associative relationship are usually regarded as implicit beliefs.

Some authors class beliefs as being epistemic versus pragmatic and dispositional versus occurrent. (Stanford 2010) With an *epistemic belief*, there is evidence for the belief. With *pragmatic belief*, there are practical reasons for the belief. Having been engaged in terrorist training, for example, would probably yield an epistemic belief that the subject has some inclination for terrorism. Pascal's argument to believe in God is an example of a pragmatic belief. It reads as follows: "The consequences of failing to believe in Him if he exists (eternal fire and damnation) are much worse than the consequences of believing in Him if he does not exist (sin avoidance and contrition)."

Dispositional belief refers to the supposition that the subject is disposed to possess a certain stance on a topic or is inclined to a particular behavior. *Occurrent belief* refers to the assumption that the subject is actually performing a sequence of actions. The penultimate example is also an example of dispositional belief. Direct knowledge, or information obtained from a trusted source, that a subject is performing a certain action is associated with occurrent belief. In the latter case, verification of identity may be of some concern and be the difference between "belief in" and "knowledge of."

IDENTITY THEORY

The notion of identity is an important subject in philosophy, mathematics, and computer information systems. In its most general sense, identity refers to the set of characteristics that makes a subject definable. Each characteristic can be viewed as a single point in a three-dimensional Cartesian coordinate system where the axis are *subject*, *attribute*, and *value*. (Katzan 1975) Thus, the fact that George is twenty-five years old could be denoted by the triple <George, age, 25>. A set of characteristics over a given domain can uniquely identify a subject. This simple concept is the basis of identity and privacy in business, government operations, and everyday life. The notion of identity applies to organizational subjects as well as to personal subjects. An important aspect of modern identity theory is the linking of identity namespaces.

Knowledge, Attributes, and Identity

Identity is primarily used to establish a relationship between an attribute or set of attributes and a person, object, event, concept, or theory. The relationship can be direct, based on physical evidence, and in other cases, the relationship is indirect and based on a reference to other entities. In a similar vein, the relationship can be certain or uncertain, and in the latter case, based on deduction or inference. The relationship determines an element of knowledge. For example, the knowledge element "you are in your car" is a statement in which "you" and "your car" are things that exist and the "in" is a relationship. Direct knowledge is known by *acquaintance* and is evidenced by a physical connection. Indirect knowledge is determined through a reference to a particular with which the analyst is acquainted. This form is known as knowledge by *description*. (Russell 1912) *Direct knowledge* is determined through sense data, memory, or introspection. *Indirect knowledge* is determined through a reference to another particular, as in "the person who ran for congress in 2004" or through a form of self-awareness where what goes on in subject's mind, for example, is estimated by an analyst's interpretation based on experience or self-evaluation.

Synthetic knowledge reflects certainty based on evidence inherent in the attribute values at hand. *Analytic knowledge* reflects a degree of uncertainty and is determined by deduction, as in “he is the only person with that ‘attribute value’,” or by inference based on known particulars, such as “all terrorists have beards.” Inference, in this case, could be regarded as a form of derivative knowledge. The value of analytic knowledge is that it enables the analyst to exceed his or her limit of private experience. (Kant 1787)

Numerical and Qualitative Identity

Identity refers to the characteristics that make a subject the same or different. We are going to establish two forms of identity: numerical and qualitative. Two subjects are *numerically identical* if they are the same entity, such that there is only one instance. Two subject (or objects in this case) are *qualitatively identical* if they are copies or duplicates. In the popular movie *The Bourne Identity*, for example, the characters *Jason Bourne* and *David Web* are numerically identical, and the number of subjects is one. So it is with *Superman* and *Clark Kent* in another domain. On the other hand, a set of animals with the same biological characteristics – e.g., a species – is regarded as being qualitatively identical. The notion of qualitative identity is remarkably similar to the modern definition of a *category* informally defined as a collection of entities with the same characteristics, having the same values for the same attributes.

Theory of the Indiscernibles

An important aspect of identity theory is that subjects exhibit features of permanence and change, analogous to sameness and difference mentioned previously. We are going to discuss the concept of temporal identity in the next section. The notion of change implies a subject that undergoes a transformation and also possesses a property that remains unchanged. Both Locke and Hume¹ have proclaimed that change reflects the idea of unity and not of identity. Leibnitz proposed the *Theory of Indiscernibles* suggesting that subjects (i.e., objects or entities) that are indiscernible are identical. (Stroll 1967) The subject of indiscernibles has implications for cloud computing, information systems, and change. To what extent a change in a characteristic denotes a change in identity is an open item at this time and implies that there is a probabilistic aspect to identity.

Russell approaches the subject of identity from an alternate viewpoint, analogous to definite and indefinite articles. Russell proposes that a description may be of two sorts: definite and indefinite. A definite description is a name, and an indefinite description is a collection of objects x that have the property ϕ , such that the proposition ϕx is true. (Russell 1919) In the phrase *Dan Brown is a famous author*, for example, ‘Dan Brown’ is a name and the indefinite description is obvious, leading to the probabilistic link between a subject and a characteristic.

Temporal Identity

There is a rich quantity of philosophical literature on the change of identity over time. Are you the same person you were yesterday? Are there persistent attributes that allow for positive identity between time periods? As mentioned previously, entities in everyday life exhibit features of permanence and change.

¹ Locke (*An Essay concerning Human Understanding*, Book II, Chapter 27) and Hume (*A Treatise of Human Nature*, Book I, Part IV).

In the domain of personal identity, address attribute is a primary candidate for change. For example, John Smith lives at 123 Main Street. He moves out and another John Smith moves in. This is distinct possibility in a crowded city.

There is a form of *attribute duality* between a person subject and an object subject. A subject – an object, such as a residence, in this case – is characterized by who lives there. For example, rich people live on Sutton Place in New York. The discussion leads to four related concepts: *endurant identity*, *perdurant identity*, *endurant attribute*, and *perdurant attribute*. Clearly, the term *endurant* refers to a noun that does not change, where *perdurant* refers to one that does. Thus, the identity problem is essentially translated to an operant problem of “recognizing identity.”

BELIEF STRUCTURES

We are going to assign subjects to an identity set based on values of attributes that characterize that set. An *identity set* is analogous to a namespace except that we are going to view identity from an analytic basis rather than from a privacy and security perspective. Consider the following scenario:

We are trying to identify subjects that belong to a certain group G. We know about the group G and its attributes. We have a paid knowledge source K₁ that informs us that subject A is a member of G. However, K₁ is not always correct, and we know that. We have used K₁ enough to know that he provides us with information when he needs money. We have an intuitive belief of how often he is correct. Fortunately, we have another source K₂ that can supply similar information. K₂ is not as hungry for money as K₁, and his opinion frequently runs contrary to K₁'s. We would like to use analytics to combine the information from K₁ and K₂ so as to obtain a composite picture of the situation. Our resultant belief of A's membership in G is not the end of the story. The belief that we obtain of A's membership in G could then be propagated down the line to other analytic situations. However, we are going to go beyond the notion that even though subject A possesses G's attributes, it doesn't necessarily indicate that A is a member of identity set G.²

We are going to use belief structures, compatibility relations, consensus theory, and belief propagation to attack this problem. Consensus theory is a methodology for combining evidence based on Dempster-Shafer theory (Shafer 1976; Katzan 1992, 2006) and the mathematical combination of evidence (Dempster 1967). Consensus theory has commanded a considerable amount of attention in the scientific and business communities, because it allows a knowledge source to assign a numerical measure to a proposition from a problem space and provides a means for the measures accorded to independent knowledge sources to be combined. Consensus theory is attractive because conflicting, as well as confirmatory, evidence from multiple sources may be combined.

Frame of Discernment

A frame of discernment is a means of representing the possibilities under consideration, as in the following example:

$$V = \{\text{medicine, law, education}\}$$

² Consider the following statements. *All spies wear blue trousers. George wears blue trousers. Therefore, George is a spy.* The analysis does not hold unless we have corroborative evidence.

Clearly, the elements in a frame of discernment are, in fact, propositions that can be interpreted as events or states. Thus, if component s_i of system S over domain V were associated with the symbol **law**, then that state is equivalent to the proposition, “The true value of V for component s_i is **law**,” or in ordinary language, “ s_i prefers **law**.” Accordingly, the set S of propositions S_i , $S = \{S_1, S_2, \dots, S_n\}$ represents the collection of states of a system under analysis. Clearly, at an agreed upon point in time, one proposition is true and the others are false.

The basis of identity analytics is a frame of discernment (Θ). Accordingly, a knowledge source may assign a numerical measure to a distinct element of Θ , which is equivalent to assigning a measure of belief to the corresponding proposition. In most cases, the numerical measure will be a belief assignment. A measure of belief may also be assigned to a subset of Θ or to Θ itself. Consider a frame of discernment Θ and its power set denoted by 2^Θ . Given the frame $\Theta = \{a, b, c\}$, its power set is delineated as: $2^\Theta = \{\{a, b, c\}, \{a, b\}, \{a, c\}, \{b, c\}, \{a\}, \{b\}, \{c\}, \{\phi\}\}$. In identity analytics, a knowledge source apportions a unit of belief to an element of 2^Θ . This belief can be regarded as a mass committed to a proposition and represents a judgment as to the strength of the evidence supporting that proposition. When viewed in this manner, evidence focuses on the set corresponding to a proposition; this set is called a *focal set*. The support for a focal set is a function m that maps an element of 2^Θ , denoted by A , onto the interval $[0,1]$. Given a frame of discernment Θ and function $m: 2^\Theta \rightarrow [0,1]$, a support function is defined as: $m(\phi) = 0$, where

$$\begin{aligned} &\phi \text{ is the null set,} \\ &0 \leq m(A) \leq 1, \text{ and} \\ &\sum_{A \subset 2^\Theta} m(A) = 1. \end{aligned}$$

A simple support function assigns a measure of belief to the focal set A , as: $m(A) > 0$; $m(\Theta) = 1 - m(A)$; and $m(B) = 0$, for all $B \subset 2^\Theta$ and $B \neq A$. The simple support function for a focal set A assigns a portion of the total belief exactly to A and not to its subsets or supersets. The remainder of the belief is assigned to Θ , because certainty function must add up to 1, $m(\Theta) = 1 - m(A)$. It is possible that a body of knowledge or evidence supports more than one proposition, as in the following case. If $\Theta = \{a, b, c, d\}$, $A = \{a, b\}$, and $B = \{a, c, d\}$, then the evidence supports two focal sets, which in the example, are A and B . If $m(A) = 0.5$ and $m(B) = 0.3$, then $m(\Theta) = 0.2$. A support function with more than one focal set is called a *separable support function*. Separable support functions are normally generated when simple support functions are combined. The notion of combining simple support functions is a practical approach to the assessment of evidence. An analyst obtains information from a knowledge source, and it leads to an immediate conclusion – not with certainty, but with a certain level of belief. This is a straightforward means of handling human affairs and is precisely what people do when analyzing situations in everyday life. If additional information comes in, the various pieces of evidence are combined to obtain a composite picture of the situation.

Compatibility Relations

In this particular instance, we are going to establish relations between three sets and the frames of discernment for K_1 , K_2 , and A , where the K_i are the knowledge sources and A is the subject. The relations will be represented as:

$$\begin{aligned} K_1 &\rightarrow A \\ K_2 &\rightarrow A \end{aligned}$$

and the frames:

$$\begin{aligned} A &= \{m, n\} \\ K_1 &= \{r, u\} \\ K_2 &= \{c, i\} \end{aligned}$$

The question is whether A is a member of G, denoted by m, or not a member of G, denoted by n. As far as K_1 is concerned, he might be telling us what he thinks we want to hear, so his judgment is classed as reliable, denoted by r, or unreliable, denoted by u. K_2 is simply correct or incorrect, denoted by c or i, respectively.

We can now establish the requisite compatibility relations, based on the fact that K_1 informs us that A is a member of G, and K_2 informs us that A is not a member of G.

1. If K_1 has based his opinion on credible evidence and is operating in a trustworthy manner, then he is in state r that is compatible with state m for A. If K_1 just needs the money or doesn't have good evidence, then he is in state u that is compatible with both states m and n. Thus, we have the compatibility relation:

$$\{(r, m), (u, m), (u, n)\}$$

2. If K_2 is behaving as normal, and there is no reason at this point not to accept that, then he is in state c that is compatible with state n for A. If K_2 is in state i then all bets are off, and this state is compatible with A's states m and n. We then have the second compatibility relation, which is:

$$\{(c, n), (i, m), (i, n)\}$$

Compatibility relations will allow us to assign belief to the assertions of K_1 and K_2 and propagate that belief through the belief network, resulting in a set of focal sets that can be combined using Dempster's rule in order to obtain a composite picture of the situation. Up to this point, we are working in the problem space for the analysis.

Prior Belief

An analyst assigns a measure of credibility to a knowledge source. In our example, let the belief assigned to K_1 be denoted by p and the belief assigned to K_2 be denoted by q , yielding the following prior belief:

<i>Source</i>	<i>Belief</i>
K_1	$\{(r), p\}. \{(r, u), 1-p\}$
K_2	$\{(c), q\}. \{(c, i), 1-q\}$

Since we are in the problem space, our belief in K_1 and K_2 is invariant.

Belief Propagation

Belief propagation transfers the knowledge from the problem space to the solution space using the compatibility relations, resulting in the following focal sets:

<i>Source</i>	<i>Focal Set</i>
K_1	$\{(m), p\}. \{(m, n), 1-p\}$
K_2	$\{(n), q\}. \{(m, n), 1-q\}$

The results of belief propagation assign the mass of the information received from K_1 to (m) and the remainder of the belief is assigned to (m, n), which is the frame, denoted by Θ in the above introduction. A similar argument applies to K_2 such that the mass of that belief is assigned to (n) and Θ , respectively.

Combination of Evidence

Using Dempster’s rules of combination (Dempster op cit.), the resulting focal sets can be combined yielding the following assessment in the solution space: (see the *appendix*)

$$\left[(m), \frac{p(1-q)}{1-pq} \right], \left[(n), \frac{(1-p)q}{1-pq} \right], \left[(m, n), \frac{(1-p)(1-q)}{1-pq} \right]$$

using symbolic math from calculations in *Mathematica*TM. Applying the expression to several values of p and q yields the following results:

$K_1(p)$	$K_2(q)$	$K_1 \oplus K_2$
.6	.7	{[(m), 0.310], [(n), 0.483], [(m, n), 0.207]}
.7	.8	{[(m), 0.318], [(n), 0.545], [(m, n), 0.136]}
.8	.9	{[(m), 0.286], [(n), 0.643], [(m, n), 0.071]}
.7	.5	{[(m), 0.538], [(n), 0.231], [(m, n), 0.231]}

This is what we wanted to show. QED.

SUMMARY

We have introduced the theory of identity and applied it to the combination of knowledge for assessment of whether a subject is a member of a certain group. We have introduced belief structures and a relevant methodology for mapping a problem space into a solution space.

APPENDIX: COMBINATION OF EVIDENCE

A method of combining evidence is known as Dempster’s rule of combination (Dempster 1967). Evidence would normally be combined when it is obtained from two different observations, each over the same frame of discernment. The combination rule computes a new support function reflecting the consensus of the combined evidence.

If m_1 and m_2 denote two support functions, then their combination is denoted by $m_1 \oplus m_2$ and is called their *orthogonal sum*. The combination $m_1 \oplus m_2$ is computed from m_1 and m_2 by considering all products of the form $m_1(X) \bullet m_2(Y)$, where X and Y range over the elements of Θ ; $m_1(X) \bullet m_2(Y)$ is the set intersection of X and Y combined with the product of the corresponding probabilities.

For example, consider the frame of discernment

$$\Theta = \{h, t, s\}$$

and views A and B, based on two different observations over the same frame:

$$X = \{\{h\}, 0.6\}, \{\{t\}, 0.3\}, \{\{s\}, 0.1\}\}$$

$$Y = \{\{h\}, 0.4\}, \{\{t\}, 0.4\}, \{\{s\}, 0.2\}$$

The entries are combined, as follows, using Dempster's rule of combination:

$$\begin{aligned} m_1 \oplus m_2(\{h\}) &= 0.24 \\ m_1 \oplus m_2(\{t\}) &= 0.12 \\ m_1 \oplus m_2(\{s\}) &= 0.02 \\ m_1 \oplus m_2(\{\emptyset\}) &= 0.62 \end{aligned}$$

Thus, for $A_i \cap B_j = A$ and $m_1 \oplus m_2 = m$, the combination rule is defined mathematically as:

$$m(A) = \frac{\sum_{A_i \cap B_j = A} m_1(A_i) \bullet m_2(B_j)}{1 - \sum_{A_i \cap B_j = \emptyset} m_1(A_i) \bullet m_2(B_j)}$$

The denominator reflects a normalization process to insure that the pooled values sum to 1. So, in this instance, the normalization process yields the combination

$$X \oplus Y = \{\{h\}, 0.63\}, \{\{t\}, 0.32\}, \{\{s\}, 0.05\}$$

after normalization by dividing the combined assessment by (1-0.62) or 0.38. Because the problem is well-structured, the representation can be simplified as

$$X \oplus Y = \{0.63, 0.32, 0.05\}$$

For views $A = \{A_1, A_2, \dots, A_n\}$ and $B = \{B_1, B_2, \dots, B_n\}$, the combination rule can be simplified as

$$A \oplus B = \{A_1 \times B_1 / k, A_2 \times B_2 / k, \dots, A_n \times B_n / k\}$$

where

$$k = \sum_{i=1}^n A_i \times B_i$$

We will refer to latter the equation as the *simplification rule*. (Katzan 2009) Readers are directed to Shafer (1976) and Katzan (1992) for additional information on Dempster's rule of combination.

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Extending the Optimal Process Mean Problem for Single and Multiple Quality Characteristics

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ABSTRACT

Within the manufacturing industry, one engineering problem of particular interest is the identification of the optimal process mean. As the product defect rate and the degree of product quality are strongly influenced by the location of the process mean, solving this problem can frequently lead to increased economic potential for the manufacturer. The traditional model involves making assumptions on the process parameters and subsequently identifying the optimal mean based upon a given cost structure. In contrast, this research proposes using a methodology that removes the assumptions made on the parameters, thus facilitating its application among manufacturing practices.

INTRODUCTION

Problem Background

In order to survive economically, the manufacturing workplace will often seek more cost-effective production strategies. Many engineers over the past sixty years have turned to the optimal process mean problem to achieve this objective. The origins of this research date back to the early 1950's when Springer [1] conducted experiments to determine the optimal fill level for cans, given a lower and upper specification limit. Frequently referred to as the "canning problem", the competing costs of over or under-filling the cans persuaded engineers to seek an optimal fill level for the process. Since then, researchers have employed a wide number of methods to identify the optimal setting of process parameters without sacrificing the quality of the product.

For most early researchers, the focus of solving the optimal process mean problem was on reducing the number of defective products resulting from a process. Given a set of product specification limits, Hunter and Kartha [2], Bisgaard *et al.* [3], and Golhar and Pollock [4] examined varying cost and profit relationships that suggested an ideal location for the process mean. In the mid-80's, the contributions of Taguchi [5] extended the process mean problem to consider the deviation of a process mean from its target value rather than solely consider the ability of a product to conform to its specification limits. By integrating a loss function into the problem, the researcher was then able to model a reduction in product quality, hence including the viewpoint of the customer into the production process. While some researchers, such as Mukhopadhyay and Chakraborty [6], and Rahim and Shaibu [7], turned to the quadratic loss function to capture this viewpoint, others looked at asymmetric or inverted loss functions, such as with Moorhead and Wu [8], and Spiring [9].

In the last twenty years, the complexity of optimal process mean research has increased considerably with the aid of high-performance computing systems. Arcelus and Rahim [10], Elsayed and Chen [11], and Teeravarapug and Cho [12] developed models to identify the optimal process mean when multiple quality characteristics are considered. Shao *et al.* [13], Roan *et al.* [14], and Rahim and Tuffaha [15] applied algorithms such as the Newton-Raphson method, the Golden Section search, and the Generalized Reduced Gradient method to the optimal process mean problem. More recent approaches to solving this

problem have focused either on applying new concepts or using less common quality characteristics of interest. Fuzzy logic models, which are meant to integrate concepts associated with human reasoning and decision-making, were used by researchers such as Shipley *et al.* [16] and Tahera *et al.* [17]. And, researchers such as Hong *et al.* [18] and Tahera *et al.* [19] developed optimal process target models for smaller-the-better (S-type) and larger-the-better (L-type) quality characteristics, respectively. A recent review of optimal process mean literature conducted by Tahera *et al.* [20] covered many of the most recent developments in this research field.

While the progress made with respect to the optimal process mean problem is significant, there remains considerable need for further advancement. In the traditional approach, a model begins with the assumption of the process mean and variance; then, based upon the competing costs to rework or reject defective products, an optimal mean for the process is identified. An alternative approach to the process mean problem, however, is to develop estimates of the process parameters through the integration of a design-of-experiments methodology. By replicating the observations made on a quality characteristic of interest, an engineer may be able to approximate the true mean and variance of the process, thus removing the need to make assumptions on the process parameters. An outline of the procedural steps for this methodology is shown in Figure 1.

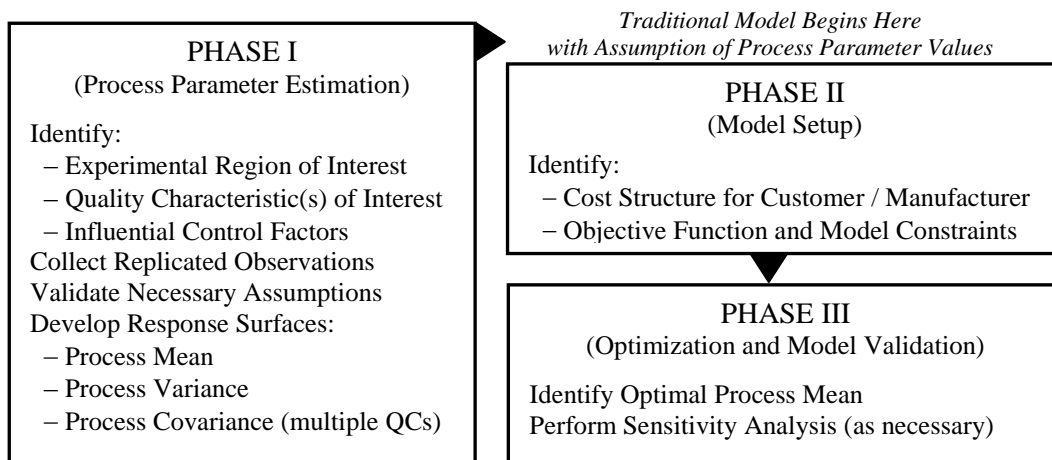


Figure 1: Procedural Outline for Proposed Methodology

Following the development of this methodology, a numerical example will be used to illustrate its use in practice.

METHODOLOGY DEVELOPMENT

The development of the proposed methodology is shown in the following paragraphs for the univariate case. As the numerical example will later illustrate, however, it can be easily extended to the case when multiple characteristics are considered.

Phase I: Process Parameter Estimation

Suppose that observations are made on a quality characteristic of interest Y , which is influenced by a set of control factors X_1, X_2, \dots, X_v . Given an experimental framework where n runs or design points are conducted and m replications are performed at each of these design points, let y_{jq} be the q th observation at the j th design point, where $j = 1, 2, \dots, n$ and $q = 1, 2, \dots, m$. A format for such an experiment is shown in Table 1.

Table 1: Experimental Format

Run	\mathbf{x}	Y (Replications)		\bar{y}	s^2
1		y_{11}	$y_{12} \dots y_{1q} \dots y_{1m}$	\bar{y}_1	s_1^2
2		y_{21}	$y_{22} \dots y_{2q} \dots y_{2m}$	\bar{y}_2	s_2^2
.	
.	Control
.	Factor
j	Settings	y_{j1}	$y_{j2} \dots y_{jq} \dots y_{jm}$	\bar{y}_j	s_j^2
.	
.	
.	
n		y_{n1}	$y_{n2} \dots y_{nq} \dots y_{nm}$	\bar{y}_n	s_n^2

For $j = 1, 2, \dots, n$, the mean and variance estimators at the j th design point are calculated using the following formulas:

$$\bar{y}_j = \frac{\sum_{q=1}^m y_{jq}}{m} \quad s_j^2 = \frac{\sum_{q=1}^m (y_{jq} - \bar{y}_j)^2}{m-1} \quad (1)$$

Prior to the development of estimator functions for the mean and variance, a general fitted line can be used to test the validity of the assumptions in the data. In particular, the assumptions of normality, constant variance, and correlation among the residuals are investigated utilizing graphical procedures. Upon suspecting a violation of these assumptions, an appropriate hypothesis test may be conducted to confirm the results, and remedial measures may be applied to support using least squares regression, if necessary. Upon completion of these steps, response surface functions are developed for the mean and variance. Using the mean response \bar{y} , the general form of the estimated response function for the process mean with k parameters or $k-1$ predictor variables may be written as:

$$\hat{\mu}(\mathbf{x}) = \mathbf{X}\hat{\beta}_\mu, \text{ where } \hat{\beta}_\mu = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\bar{\mathbf{y}}, \mathbf{X} = \begin{bmatrix} 1 & X_{11} & \dots & X_{1,k-1} \\ 1 & X_{21} & \dots & X_{2,k-1} \\ \vdots & \vdots & \ddots & \vdots \\ 1 & X_{n1} & \dots & X_{n,k-1} \end{bmatrix}, \text{ and } \bar{\mathbf{y}} = [\bar{y}_1, \bar{y}_2, \dots, \bar{y}_n]' \quad (2)$$

In similar fashion, a fitted response surface function is developed for the variance (Equation 3), with the corresponding \mathbf{s}^2 vector containing the supporting information for this particular parameter. For details on the selection of the variance as an estimated response surface function rather than standard deviation, see Goethals *et al.* [21].

$$\hat{\sigma}^2(\mathbf{x}) = \mathbf{X}\hat{\beta}_{\sigma^2}, \text{ where } \hat{\beta}_{\sigma^2} = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{s}^2, \text{ and } \mathbf{s}^2 = [s_1^2, s_2^2, \dots, s_n^2]' \quad (3)$$

Phase II: Model Setup

Given a manufactured product with normally distributed quality characteristic Y , manufacturing costs are incurred when the product fails to meet either the established lower or upper specification limit, LSL or USL , respectively. Specifically, the cost to rework products RC_1 is applied when product measurements

fall short of the pre-defined LSL , and a rejection cost RC_{II} is applied when quality characteristic measurements extend beyond the USL . Furthermore, consider applying an additional cost to the customer when product measurements meet specifications but fail to achieve a desired target value τ . In particular, the univariate quadratic Taguchi quality loss function took the form $L(y) = \delta (y-\tau)^2$, where $L(y)$ is a measure of the loss in quality associated with the quality characteristic Y , and δ is the quality loss coefficient which depends on the magnitude or loss impact of the characteristic. In taking a quality loss-based approach with economic considerations, the aim is then to minimize the expected total cost (TC), which is a function of both the customer and manufacturer costs.

$$\text{Minimize } E[TC] = \int_{LSL}^{USL} \delta(y-\tau)^2 \cdot f(y)dy + \int_{-\infty}^{LSL} RC_I \cdot f(y)dy + \int_{USL}^{\infty} RC_{II} \cdot f(y)dy \quad (4)$$

The design of the constraints for any given process may take on a number of different forms. At a minimum, restrictions should be implemented to ensure that y is normally distributed and the process mean for the distribution of y lies within the boundaries of the specification limits. Unlike previous attempts to employ these constraints, however, the true mean and variance for a normally-distributed quality characteristic within a process are more closely estimated using the proposed methodology.

$$f(y) = \frac{1}{\sqrt{2\pi\hat{\sigma}^2}} \exp\left\{-\frac{1}{2}\left[\frac{(y-\hat{\mu})^2}{\hat{\sigma}^2}\right]\right\}, \text{ where } LSL \leq \hat{\mu}(\mathbf{x}) \leq USL \quad (5)$$

Phase III: Optimization and Model Validation

Using the mean and variance response surface functions generated in Phase I and the selection of the objective and constraints in Phase II, the proposed nonlinear optimization scheme is outlined in Table 2.

Table 2: Proposed Optimization Scheme for the Process Mean Problem (Univariate Case)

Minimize	$E[TC] = \int_{LSL}^{USL} \delta(y-\tau)^2 \cdot f(y)dy + RC_I \cdot \int_{-\infty}^{LSL} f(y)dy + RC_{II} \cdot \int_{USL}^{\infty} f(y)dy$
Satisfy	Constraints:
	1. $f(y) = \frac{1}{\sqrt{2\pi\hat{\sigma}^2}} \exp\left\{-\frac{1}{2}\left[\frac{(y-\hat{\mu})^2}{\hat{\sigma}^2}\right]\right\}$, with $-\infty < y < \infty$
	2. $\mathbf{x}^T \mathbf{x} \leq \rho^2$ (central composite design) or $-1 \leq X_i \leq 1$ (fractional factorial design)
	3. $LSL \leq \hat{\mu}(\mathbf{x}) \leq USL$
Given	Control factors, \mathbf{x} , and Responses, \mathbf{y} Fitted response models: Mean $\hat{\mu}(\mathbf{x}) = \mathbf{X}\hat{\beta}_\mu$, where $\hat{\beta}_\mu = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\bar{\mathbf{y}}$ and $\bar{\mathbf{y}} = [\bar{y}_1, \bar{y}_2, \dots, \bar{y}_n]'$ Variance $\hat{\sigma}^2(\mathbf{x}) = \mathbf{X}\hat{\beta}_\sigma$, where $\hat{\beta}_\sigma = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{s}^2$ and $\mathbf{s}^2 = [s_1^2, s_2^2, \dots, s_n^2]'$ Desired target value, τ Quality loss setting, δ
Find	Optimal factor settings $\mathbf{x}^* = [X_1^*, X_2^*, \dots, X_v^*]$

NUMERICAL EXAMPLE

Consider an adaptation of an experiment introduced by Derringer and Suich [22] involving a process for the production of a tire tread compound. In this study, observations are taken on three control factors – hydrated silica level (X_1), silane coupling agent level (X_2), and the sulfur level (X_3). The experiment is replicated three times and the effects of setting these factors at various levels are noted for two nominal-the-best quality characteristics of interest. The tensile strength (Y_1), measured in megapascals (MPa), possesses a desired target value of 12.6 MPa, with an *LSL* and *USL* of 11 MPa and 14.2 MPa, respectively. In addition, observations are taken on the energy at break (Y_2) for the tire tread, measured in joules (J), where a target of 16.1 J is desired and an *LSL* and *USL* of 14.0 J and 18.2 J, respectively, are implemented. Table 3 displays the data collected for this experiment, along with the calculations for the mean, variance, and covariance at each of the design points.

Table 3: Experimental Design for the Tire Tread Production Process

Run	Coded Units			Tensile Strength (Y_1)			Energy at Break (Y_2)			Covariance
	Silica X_1	Silane X_2	Sulfur X_3	3 reps. (MPa)	\bar{y}_1	s_1^2	3 reps. (J)	\bar{y}_2	s_2^2	s_{12}
1	-1	-1	-1	11.9, 12.7, 12.3	12.3	0.16	15.1, 15.0, 14.3	14.8	0.19	-0.013
2	1	-1	-1	11.3, 11.9, 11.6	11.6	0.09	14.3, 14.2, 13.2	13.9	0.37	-0.010
3	-1	1	-1	13.4, 14.1, 14.5	14.0	0.31	17.6, 17.1, 17.5	17.4	0.07	-0.033
4	1	1	-1	10.4, 10.6, 10.5	10.5	0.01	19.4, 19.2, 18.7	19.1	0.13	-0.007
5	-1	-1	1	13.8, 13.3, 13.4	13.5	0.07	18.2, 18.1, 18.6	18.3	0.07	-0.007
6	1	-1	1	12.3, 12.1, 12.2	12.2	0.01	15.3, 15.4, 16.4	15.7	0.37	-0.003
7	-1	1	1	11.2, 11.1, 11.3	11.2	0.01	13.8, 14.5, 14.3	14.2	0.13	-0.007
8	1	1	1	11.7, 11.2, 11.6	11.5	0.07	17.7, 18.2, 18.4	18.1	0.13	-0.027
9	-1.682	0	0	13.8, 14.3, 13.9	14.0	0.07	17.0, 17.2, 17.4	17.2	0.04	0.007
10	1.682	0	0	10.4, 11.0, 10.7	10.7	0.09	15.7, 16.0, 15.1	15.6	0.21	0.030
11	0	-1.682	0	12.8, 12.6, 13.0	12.8	0.04	16.1, 16.3, 16.5	16.3	0.04	0.013
12	0	1.682	0	10.4, 11.6, 11.0	11.0	0.36	16.3, 16.1, 15.3	15.9	0.28	-0.040
13	0	0	-1.682	13.0, 12.5, 12.9	12.8	0.07	15.6, 15.5, 15.1	15.4	0.07	-0.007
14	0	0	1.682	12.2, 12.9, 12.4	12.5	0.13	17.9, 17.6, 17.3	17.6	0.09	-0.020
15	0	0	0	12.9, 13.0, 13.7	13.2	0.19	16.4, 17.2, 16.8	16.8	0.16	0.013
16	0	0	0	13.2, 12.6, 12.9	12.9	0.09	17.2, 17.1, 17.0	17.1	0.01	0.010
17	0	0	0	12.6, 12.2, 12.4	12.4	0.04	15.9, 16.1, 16.6	16.2	0.13	-0.013
18	0	0	0	12.1, 12.7, 12.4	12.4	0.09	16.4, 16.2, 15.1	15.9	0.49	-0.020
19	0	0	0	12.9, 12.5, 12.7	12.7	0.04	16.1, 16.0, 17.1	16.4	0.37	0.007
20	0	0	0	12.4, 12.5, 12.9	12.6	0.07	16.6, 15.5, 16.2	16.1	0.31	-0.003

The Univariate Case

Suppose that the objective of the experiment is to identify the optimal process mean μ^* for the tensile strength Y_1 and the factor settings that support obtaining this mean. While finished material that fails to meet the pre-defined *LSL* may be reprocessed at a small labor cost, material products that fail to meet the *USL* must be completely discarded and incur a significantly higher cost. When the sixty observations for Y_1 are loaded into an input analyzer program, the normal distribution is found to most closely model this particular quality characteristic of interest (see Figure 2).

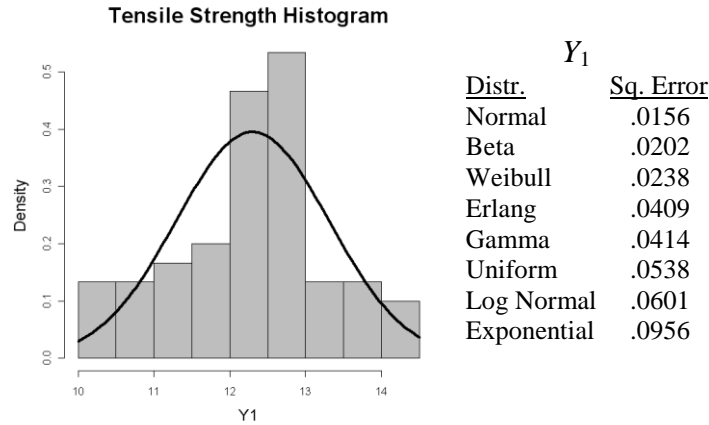


Figure 2: Modeling the Tensile Strength Y_1 for the Tire Tread Production Process

The normality assumption in Y_1 can be further supported by the results of the Shapiro-Wilk test. Given p observations ordered from smallest to largest values, $y_{(1)}, y_{(2)}, \dots, y_{(p)}$, and the alternative hypotheses $H_0: Y_1 \in N(\mu, \sigma^2)$ and $H_1: Y_1 \notin N(\mu, \sigma^2)$, the W statistic is computed:

$$W^* = \left[\frac{b}{s\sqrt{p-1}} \right]^2, \text{ where } b = \sum_{u=1}^{\gamma} a_{p-u+1} [y_{(p-u+1)} - y_u],$$

γ is the largest integer less than or equal to $p/2$, and s is the sample standard deviation. For a given level of significance α , tables are used to reference the coefficients a and the critical values W_α . Unlike most tests, since the critical region is in the small tail of the distribution, if $W^* > W_\alpha$, H_0 is concluded, i.e. sufficient evidence exists to suggest the characteristic is normally distributed. For Y_1 , using $\alpha = .05$, the test statistic W^* is given as:

$$W_{Y_1}^* = \left[\frac{b_{Y_1}}{s_{Y_1}\sqrt{p-1}} \right]^2 = \left[\frac{7.7073}{1.01718\sqrt{59}} \right]^2 = .9731$$

Since $W_{Y_1}^* = .9731 > W_{.05} = .951$, sufficient evidence exists to support the normality of Y_1 .

In order to support the use of regression procedures in the development of response surface functions for Y_1 , an investigation of the residuals using a standard fitted line should be performed. Specifically, the assumptions of normality, constant variance, and a lack of correlation among the residuals are examined (see Figure 3). Based upon these findings, there appear to be no serious departures from normality, and the residuals appear to be uncorrelated and exhibiting relatively constant variance. Second-order response surface functions are then developed for the mean and variance of the quality characteristic Y_1 :

$$\begin{aligned} \hat{\mu}(\mathbf{x}) &= 12.7057 - 0.7871X_1 - 0.3974X_2 - 0.0369X_3 - 0.1608X_1^2 - 0.3199X_2^2 - 0.0548X_3^2 \\ &\quad - 0.1500X_1X_2 + 0.4000X_1X_3 - 0.4500X_2X_3 \\ \hat{\sigma}^2(\mathbf{x}) &= 0.0879 - 0.0246X_1 + 0.0445X_2 - 0.0226X_3 - 0.0103X_1^2 + 0.0321X_2^2 - 0.0033X_3^2 \\ &\quad - 0.0138X_1X_2 + 0.0463X_1X_3 - 0.0088X_2X_3 \end{aligned}$$

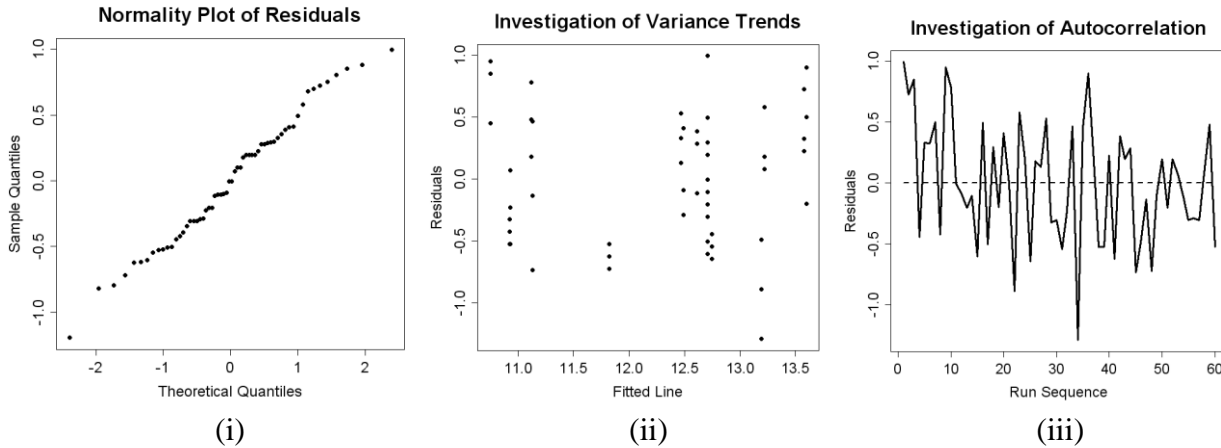


Figure 3: Investigating Y_1 – (i) Normality, (ii) Constant Variance, and (iii) Residual Correlation

Using the response surface functions for the mean and variance, a non-linear constrained optimization scheme is employed that seeks to identify the optimal factor settings for which the total processing costs are minimized. Restrictions are implemented to ensure Y follows a normal distribution and the process mean lies within the boundaries of the specification region. The ratio of the associated rejection to rework costs, $RC_2:RC_1$, is established at 8:1 and the quality loss coefficient is established at $\delta = 0.20$, in order to provide an appropriate degree of cost to the manufacturer for non-conforming products. To ensure a level of realism is applied to the problem, a lower bound is also placed on the process variance for the characteristic. The result is the optimization scheme shown in Table 4.

Table 4: Optimization Scheme for the Tire Tread Process Mean Problem (Univariate Case)

Minimize	$E[TC] = 0.2 \cdot \int_1^{4.2} (y - 12.6)^2 \cdot f(y) dy + 100 \cdot \int_{-\infty}^1 f(y) dy + 800 \cdot \int_{4.2}^{\infty} f(y) dy$
Satisfy	Constraints:
	1. $f(y) = \frac{1}{\sqrt{2\pi\hat{\sigma}^2}} \exp\left\{-\frac{1}{2} \left[\frac{(y - \hat{\mu})^2}{\hat{\sigma}^2}\right]\right\}$, with $-\infty < y < \infty$
	2. $\mathbf{x}^T \mathbf{x} \leq 3$ (bound on experimental region)
	3. $11 \leq \hat{\mu}(\mathbf{x}) \leq 14.2$, $\hat{\sigma}^2(\mathbf{x}) \geq 0.5$
Given	Desired target value $\tau = 12.6$ Quality loss coefficient $\delta = 0.2$
	$\hat{\mu}(\mathbf{x}) = 12.7057 - 0.7871X_1 - 0.3974X_2 - 0.0369X_3 - 0.1608X_1^2 - 0.3199X_2^2 - 0.0548X_3^2$ $- 0.1500X_1X_2 + 0.4000X_1X_3 - 0.4500X_2X_3$
	$\hat{\sigma}^2(\mathbf{x}) = 0.0879 - 0.0246X_1 + 0.0445X_2 - 0.0226X_3 - 0.0103X_1^2 + 0.0321X_2^2 - 0.0033X_3^2$ $- 0.0138X_1X_2 + 0.0463X_1X_3 - 0.0088X_2X_3$

Based upon the given information and constraint system for this example, the optimal factor settings $\mathbf{x}^* = [X_1^*, X_2^*, X_3^*]$ are identified in Table 5 below, along with the corresponding optimal process mean and the expected total cost.

Table 5: Tire Tread Process Optimal Process Mean Problem Results (Univariate Case)

\mathbf{x}^*	μ^*	$E[TC]$
(-0.836685, 1.22866, 0.254718)	12.478	0.137312

Hence, the optimal process mean may be achieved by setting the hydrated silica level, silane coupling agent level, and sulfur level at their corresponding uncoded settings. It is noted that the expected total cost for maintaining the original process mean of 12.6 is $E[TC] = 0.195775$, suggesting that a cost savings of 29.8% would be achieved by going with the adjusted process mean value for this example. To determine the robustness of the model, an engineer may examine the effects of altering various constraints on the expected total cost. Shown in Figure 4 (i) are normally distributed models of the original process (dashed) at $\tau = 12.60$ and the adjusted process (solid line) at $\tau = 12.48$, with their respective degrees of variability. The effects of relaxing both the quality loss coefficient δ and the tolerance on the location of the optimal process mean are observed in Figure 4 (ii).

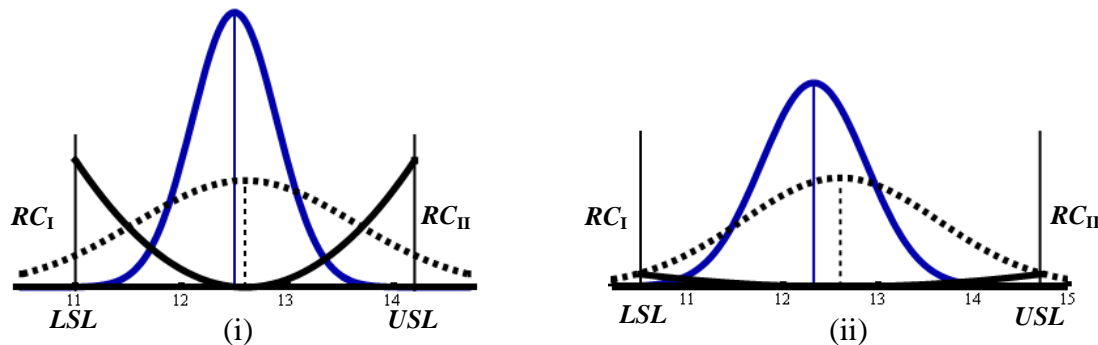


Figure 4: Original Process Model (dashed line) at $\tau = 12.6$ versus Adjusted Process Model (solid line) with (i) $\delta = 0.20$, $(LSL, USL) = (11, 14.2)$ and (ii) $\delta = 0.05$ (relaxed), $(LSL, USL) = (10.5, 14.7)$

The Bivariate Case

The numerical example can be extended to examine the case when multiple characteristics are considered. Suppose an engineer is interested in determining the optimal process mean vector $\mu^* = (\mu_1^*, \mu_2^*)'$, found by considering the settings for both Y_1 and the second characteristic in Table 3, the energy at break (Y_2) for tire tread. It can be shown that Y_2 is also normally distributed and that Y_1 and Y_2 are independent; hence, this implies that they are jointly normally distributed, i.e. $\mathbf{Y} = (Y_1, Y_2)' \sim N_2(\mu, \Lambda)$. While finished material that fails to meet only one of the two characteristics may be reprocessed at a small labor cost, material products that fail to meet both characteristics must be completely discarded and incur a significantly higher cost. This situation results in the symmetric cost structure shown in Figure 5; the ratio of rejection to rework costs is established at 8:1, similar to the univariate case.

Y_2	RC_{II}	RC_I	RC_{II}
USL_2			
τ_2	RC_I		RC_I
LSL_2			
	LSL_1	τ_1	USL_1 Y_1

Figure 5: Manufacturer Rework (RC_I) and Rejection (RC_{II}) Costs for Non-Conforming Characteristics

Finally, in order to capture the cost to the customer associated with quality loss when the process mean vector deviates from a desired target vector $\tau = (\tau_1, \tau_2)'$, a bivariate loss function is considered. In this manner, the loss coefficients δ_{11} and δ_{22} account for the degree of quality loss in Y_1 and Y_2 , respectively, when either characteristic deviates from its respective target value, while the loss coefficient δ_{12} accounts for the loss in quality associated with both Y_1 and Y_2 deviating from their respective target values. Since the energy at break characteristic is considered by many tire manufacturers to be more critical than the tensile strength, the quality loss coefficient setting is set higher for Y_2 than for Y_1 . With the development of response surface designs for the mean, variance, and covariance between characteristics, the optimization scheme shown in Table 6 is established.

Table 6: Optimization Scheme for the Tire Tread Process Mean Problem (Bivariate Case)

Minimize	
$E[TC] = 100 \cdot \left[\int_{-\infty}^{14} \int_{11}^{14.2} f(Y_1, Y_2) dY_1 dY_2 + \int_{-\infty}^{11} \int_{4}^{8.2} f(Y_1, Y_2) dY_2 dY_1 + \int_{8.2}^{\infty} \int_{11}^{14.2} f(Y_1, Y_2) dY_1 dY_2 + \int_{4.2}^{\infty} \int_{4}^{8.2} f(Y_1, Y_2) dY_2 dY_1 \right] + 800 \cdot \left[\int_{-\infty}^{11} \int_{-\infty}^{14} f(Y_1, Y_2) dY_2 dY_1 + \int_{-\infty}^{11} \int_{8.2}^{\infty} f(Y_1, Y_2) dY_2 dY_1 + \int_{4.2}^{\infty} \int_{8.2}^{\infty} f(Y_1, Y_2) dY_2 dY_1 + \int_{4.2}^{\infty} \int_{-\infty}^{14} f(Y_1, Y_2) dY_2 dY_1 \right] + \int_{4}^{8.2} \int_{11}^{14.2} L(Y_1, Y_2) \cdot f(Y_1, Y_2) dY_1 dY_2$	
Satisfy	<p>Constraints:</p> <ol style="list-style-type: none"> $f(Y_1, Y_2) = \frac{1}{2\pi\sqrt{ \hat{\Lambda} }} \exp\left[-\frac{1}{2}(\mathbf{Y} - \hat{\boldsymbol{\mu}})' \hat{\Lambda}^{-1}(\mathbf{Y} - \hat{\boldsymbol{\mu}})\right]$, where $L(Y_1, Y_2) = \delta_{11}(Y_1 - \tau_1)^2 + \delta_{12}(Y_1 - \tau_1)(Y_2 - \tau_2) + \delta_{22}(Y_2 - \tau_2)^2$ $\mathbf{x}^T \mathbf{x} \leq 3$ (bound on experimental region) $11 \leq \hat{\mu}_1(\mathbf{x}) \leq 14.2, 14 \leq \hat{\mu}_2(\mathbf{x}) \leq 18.2, \sigma_1^2(\mathbf{x}) \geq 0.5, \sigma_2^2(\mathbf{x}) \geq 0.5$
Given	<p>Desired process target vector $\tau = [\tau_1, \tau_2]' = [12.6, 16.1]'$ Quality loss coefficients $\delta_{11} = .10, \delta_{12} = .05, \delta_{22} = .30$</p> <p>$\mathbf{Y} = (Y_1, Y_2)'$, $\hat{\boldsymbol{\mu}} = (\hat{\mu}_1, \hat{\mu}_2)'$, $\hat{\Lambda} = \begin{bmatrix} \hat{\sigma}_1^2 & \hat{\sigma}_{12} \\ \hat{\sigma}_{12} & \hat{\sigma}_2^2 \end{bmatrix}$, where</p> $\hat{\mu}_1(\mathbf{x}) = 12.7057 - 0.7871X_1 - 0.3974X_2 - 0.0369X_3 - 0.1608X_1^2 - 0.3199X_2^2 - 0.0548X_3^2 - 0.1500X_1X_2 + 0.4000X_1X_3 - 0.4500X_2X_3$ $\hat{\sigma}_1^2(\mathbf{x}) = 0.0879 - 0.0246X_1 + 0.0445X_2 - 0.0226X_3 - 0.0103X_1^2 + 0.0321X_2^2 - 0.0033X_3^2 - 0.0138X_1X_2 + 0.0463X_1X_3 - 0.0088X_2X_3$ $\hat{\mu}_2(\mathbf{x}) = 16.4132 - 0.0433X_1 + 0.3974X_2 + 0.3515X_3 + 0.0171X_1^2 - 0.0889X_2^2 + 0.0525X_3^2 + 1.1375X_1X_2 + 0.0625X_1X_3 - 1.1875X_2X_3$ $\hat{\sigma}_2^2(\mathbf{x}) = 0.2428 + 0.0605X_1 - 0.0099X_2 - 0.0019X_3 - 0.0280X_1^2 - 0.0156X_2^2 - 0.0439X_3^2 - 0.0525X_1X_2 + 0.0075X_1X_3 + 0.0225X_2X_3$ $\hat{\sigma}_{12}(\mathbf{x}) = -0.0008 + 0.0038X_1 - 0.0095X_2 - 0.0002X_3 + 0.0047X_1^2 - 0.0065X_2^2 - 0.0065X_3^2 - 0.0001X_1X_2 - 0.0058X_1X_3 - 0.0008X_2X_3$

For the bivariate case, the optimal factor settings $\mathbf{x}^* = [X_1^*, X_2^*, X_3^*]$ are identified in Table 7 below, along with the corresponding process mean vector and the expected total cost.

Table 7: Tire Tread Process Optimal Process Mean Problem Results (Bivariate Case)

\mathbf{x}^*	$\boldsymbol{\mu}^*$	$E[TC]$
(0.389124, -0.575705, 0.208778)	(12.61, 16.11)	10.279

In some cases, failing to conform to one particular specification limit for a characteristic may be considerably more costly than other characteristics. For this reason, the effect of alternative cost structures may be examined. Shown in Table 8 are contour plots for the bivariate normal distribution used in this example, along with the identification of the optimal process mean under various cost structures. The contour representing 99.73% of the original process with its corresponding process mean (PM) are shown using a dashed line (---), while the contour representing 99.73% of the adjusted process with the optimal process mean (OPM) are identified using a solid line (—). The desired target value τ is identified with an "X".

Table 8: Sensitivity Analysis for the Tire Tread Process Optimal Mean Problem

Trial	Quality Loss Conditions and Optimization Results	Cost Structure Applied	Identification of the Optimal Process Mean
(i)	<p><i>Priority toward Y_2 USL</i> <i>Asymmetric Cost Structure</i></p> <p><u>Tolerance Region:</u> $LSL_1 = 11, USL_1 = 14.2$ $LSL_2 = 14, USL_2 = 18.2$</p> <p><u>Quality Loss Settings:</u> $\delta_{11} = .10, \delta_{12} = .05, \delta_{22} = .30$</p> <p>$\mathbf{x}^* = (-1.199, 0.384, 1.058)$ $\boldsymbol{\mu}^* = (12.49, 15.97)$ $E[TC] = 9.378$</p>	<p>Rejection:Rework Costs = 5:1</p>	
(ii)	<p><i>Priority toward Y_1, Y_2 LSLs</i> <i>Asymmetric Cost Structure</i></p> <p><u>Tolerance Region:</u> $LSL_1 = 11, USL_1 = 14.2$ $LSL_2 = 14, USL_2 = 18.2$</p> <p><u>Quality Loss Settings:</u> $\delta_{11} = .10, \delta_{12} = .05, \delta_{22} = .30$</p> <p>$\mathbf{x}^* = (-1.199, 0.081, 0.793)$ $\boldsymbol{\mu}^* = (12.93, 16.59)$ $E[TC] = 21.914$</p>	<p>Rejection:Rework Costs = 10:1</p>	

The most significant contribution in using this experimental approach is that the approximation of cost savings will undoubtedly have a higher degree of accuracy than in the case where the engineer assumes values for the true process mean, variance, and covariance between characteristics. The assumption of the various process parameters may create a situation where extraordinary cost savings are suggested and decisions are made to alter process conditions, when in fact, the cost savings may be negligible. With this approach, additional observations on the quality characteristic of interest may be taken at various time intervals to identify shifts in the mean or adjustments in variance for a given process.

In addition to providing more precise estimates of the process parameters, the model enables an engineer greater flexibility in modeling their respective process. The deviation of a process mean from its desired target value has different meaning depending on the quality characteristic of interest, so an appropriate loss function should be adaptable to setting higher or lower penalties. Furthermore, in some cases, the non-conformance of a product's characteristic to one specification limit may require completely different reprocessing actions than if the other specification limit is violated. Thus, asymmetric cost structures should also be examined to further broaden the scope of the process mean problem.

CONCLUSION

The identification of the optimal process mean is a popular tool for establishing more cost-effective policies. Most models developed to solve the optimal process mean problem are based upon theoretical process parameter values and thus are not readily facilitated for use within most industrial practices. By incorporating a design of experiments approach into the methodology of the process mean problem, it is more feasible for engineers to properly estimate the optimal factor settings and thereby approximate cost savings with greater accuracy. The end result of the proposed methodology is greater flexibility and increased accuracy in finding solutions that support both the manufacturer and the customer.

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COMPATIBILITY RELATIONS IN IDENTITY ANALYSIS

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ABSTRACT

Methods for categorizing certain subjects, based on belief structures, are an important aspect of modern society. In an accompanying paper, we present a method for combining belief, attributable to diverse knowledge sources, in order to obtain a measure of group membership. The scope of group identity is much greater than digital security and affects other societal endeavors. In this paper, we are going to propose methods for propagating belief through a complex network of belief assessments. The methods are known as compatibility relations. The referenced paper is *Group Association Using Identity Analysis*, included in the accompanying proceedings.

INTRODUCTION

Identity refers to the categorization of an individual and the assigning of a name to that determination. We are going to approach the subject of identity from a data analytic viewpoint, where the primary challenge is to use identity in an effective way to determine group membership. Methods have been developed for propagating belief through a complex network of belief assessments. The focus of this paper is on compatibility relations, defined as the mapping of belief between identity namespaces. This paper is intended to accompany a related paper entitled “Group Association Using Identity Analysis.” (Katzan 2010) The introductory section contains common material, so it can be read independently.

Identity Concepts

Identity is a means of denoting an entity in a particular namespace and is the basis of analytic behavior analysis. We are often afforded the identity of a person based on the judgment of a third party and are obligated to respond to that assessment. It would seem to be prudent in a civilized society to obtain additional information on the subject and combine the various items of information to obtain a composite view before engendering a timely response to the situation.

Identity is primarily used to establish a relationship between an attribute or set of attributes and a person, object, event, concept, or theory. The relationship can be direct, based on physical evidence, and in other cases, the relationship is indirect and based on a reference to other entities. Direct knowledge is known by *acquaintance* and is evidenced by a physical connection. Indirect knowledge is determined through a reference to a particular with which the analyst is acquainted. This form is known as knowledge by *description*. (Russell 1912) *Direct knowledge* is determined through sense data, memory, or introspection. *Indirect knowledge* is determined through a reference to another particular, as in “the person who was mayor in 2009.”

Belief Concepts

Belief is often regarded as a mental state in which a person holds a proposition to be true without necessarily being able to prove its truth to other persons. Even though absolute certainty is not required with belief, a person’s set of beliefs can play an important role in the causation of behavior. If a representation for belief P exists in a person’s mind, then it is an *explicit belief*. If a representation for belief Q does not exist in a person’s mind but is based on another proposition P, then it is an *implicit belief*. Beliefs that are based on an associative relationship are usually regarded as implicit beliefs.

Dispositional belief refers to the supposition that the subject is disposed to possess a certain stance on a topic or is inclined to a particular behavior. *Occurent belief* refers to the assumption that the subject is actually performing a sequence of actions. The penultimate example is also an example of dispositional belief. Direct knowledge, or information obtained from a trusted source, that a subject is performing a certain action is associated with occurent belief. In the latter case, verification of identity may be of some concern and be the difference between “belief in” and “knowledge of.”

UNCERTAINTY

Identity and uncertainty are related within the domain of identity analytics and belief propagation. When an analyst believes something but cannot prove it analytically or statistically, he or she is assigning a measure to the strength of the evidence supporting a specific proposition. In the present context, we are interested in the certainty of group membership.

Analytic Behavior

Analytic behavior is based on two related but often conflicting theories of action. At the individual level, people think in a cause-oriented fashion and use information to match existing patterns in order to make sense out of a minimal amount of information. (Campbell 1989, Tversky 1974) The mind too easily forms prototypes and constructs scenarios. At the organizational level, operational knowledge, based on a partial mapping of reality, is developed to determine how an organization responds to external stimuli and generates strategies and actions. Thus, both individuals and organizations do not typically handle uncertainty but respond to it according to existing ideologies. Implicit in this discussion is the not-so-obvious fact that we often have too much information and have a tendency to relate it to existing scenarios regardless of their applicability. In order to execute assessment in a judicious manner, a cognitive process, comprised of selection, processing, and response, is proposed as a context for identity analysis based on uncertainty.

Two forms of information are required to handle uncertainty: indicators from the real world and belief in what those indicators mean. Collectively, the combination of indicators, belief, and meaning is known as *evidence*. Evidence from independent knowledge sources should be combined to construct effective courses of action, as denoted by the lifecycle for belief revision and organizational action. (Katzan 1992)

Based on the degree to which a phenomenological system is accessible to empirical investigation, three modalities have been established: (Sutherland 1975)

- *Empirico-inductive modality* in which facts can be determined from observation and principles can be derived from facts.
- *Hypothetico-deductive modality* in which hypotheses are based on intuition, imagination, and other intellectual methods and deductive methods are used to verify predictions with observations.
- *Knowledge-based modality* that is characterized by key indicators serving as access keys to information structures and response scenarios, as in medical diagnosis, wherein knowledge structures are organized as a complex network of relationships.

Although identity analysis would essentially employ the three modalities, as required, the emphasis would necessarily focus on the knowledge-based modality, since indicators can certainly give some insight into the true state of reality – but not always with certainty.

Uncertain Reasoning

Most information systems treat information as though it was a proven fact, but in actuality, this is rarely the case. In addition, inferences based on so-called exact information are equally uncertain. Valid inference relations should take the form:

if x then y with confidence m

where the confidence factor m reflects the degree of confidence that a domain expert assigned to the inference relation. The uncertainty in this case is the reflection of one or more of the following conditions: (1) Inherent uncertainty in the possibility set; (2) Incomplete evidence; and (3) Incorrect evidence because of measurement errors. The uncertainty, incompleteness, and incorrectness of information are the reasons we wish to model identity information from the viewpoint of uncertain reasoning.

Degrees of Belief

In order to investigate degrees of belief, we are going to employ the following construct:

if x then y (to degree a)

and refer to the expression as an inference rule. Here are some examples:

if the patient has a large lump
then there is evidence (0.7) that medical tests are necessary.

if housing starts are up
then there is evidence (0.6) that interest rates will also rise within 6 months.

The certainty factor in an inference rule is an expression of its inherent uncertainty. There is frequently some uncertainty in the antecedents, as well, because of reasons given in the previous section. This prospect is demonstrated in the following example:

if the patient has a large lump (0.7)
and the patient's blood is weak (0.4)
then there is strong evidence (0.9) that the patient should go to the hospital for treatment.

In this example, the evidence of a large lump is uncertain (0.7) because of the vagueness of the word "large," and similarly with the evidence for "weak" blood (0.4). The certainty associated with the rule is, in this case, equal to (0.9).

In the antecedent part of a rule, evidence is combined in accordance with the following definitions for the logical operators:

p and q = min (p , q)	<i>The smaller</i>
p or q = max (p , q)	<i>The larger</i>
not p = $1-p$	<i>The inverse</i>

The rules are then evaluated according to the following steps:

1. If the antecedent is a logical expression, then it is evaluated as covered.
2. The belief for the conclusion produced by a rule is the belief for the antecedent multiplied by the certainty associated with the rule.
3. The belief for a fact produced as the conclusion of one or more rule evaluations is the maximum of the beliefs produced by all of the rules that yield that conclusion.

Example:

Rule 1

if a and b and c then d (certainty = 0.7)

Rule 2

if h or i then d (certainty = 0.8)

Assume that facts a , b , c , h , and i have beliefs of 0.7, 0.3, 0.5, 0.7, and 0.9, respectively. The following computation produced a belief of 0.72 for d :

$\min(a, b, c) = \min(0.7, 0.3, 0.5) = 0.3$	<i>By step 1</i>
<i>Belief for rule 1</i> = $0.3 \times 0.7 = 0.21$	<i>By step 2</i>
$\max(h, i) = \max(0.7, 0.9) = 0.9$	<i>By step 1</i>
<i>Belief for rule 2</i> = $0.9 \times 0.8 = 0.72$	<i>By step 2</i>
$\max(\text{Belief for rule 1}, \text{Belief for rule 2}) = 0.72$	<i>By step 3</i>

This is the inference method used for possibility theory (Fuzzy Set Theory). (Zadeh 1986) The results are not confirmatory but illustrate the gist of belief propagation.

Assignment of Belief

The assignment of belief involves the association of a basic probability assignment to the uncertainty inherent in a mutually exclusive and exhaustive set of possibilities. In some instances, the assignment of belief can be made by using the probability values in another probability space. (Neapolitan 1990)

Consider the task of determining the price of equity DS. Let R stand for the proposition, "The value of DS will rise," and let S represent the proposition, "Sam predicts the value of DS will rise." It would be desirable to have the conditional probability of R given S, i.e., $P(R|S)$, but that information is unfortunately not available through repeated trials.

On the other hand, Sam is a crackerjack analyst, and given that he has performed a thorough fundamental analysis of an equity, it will unquestionably rise if Sam says it will. However, Sam is a busy guy, and coupled with the fact that Sam has quite an ego, the situation sometimes results in Sam giving an investment opinion off the cuff, when he hasn't done his homework. Assume that Sam does his homework 70% of the time and let H represent the proposition, "Sam has done his homework." Thus, $P(H) = 0.70$ in this instance.

We are seeking the probability of R and can use the probabilities in another probability space to infer it. Now if H is true, then events H and R are compatible and we have the relationship:

$$m_1(\{R\}) = P(H) = 0.7$$

where m_1 represents the mass afforded to the enclosed proposition. (Katzan 1992, 2008, 2010) The other 30% of the time, Sam takes an educated guess, so all bets are off. Thus, the complement of H, namely H^c , is compatible with R and R^c , so we have:

$$m_1(\{R, R^c\}) = P(H^c) = 0.3$$

In this instance, Sam has predicted that DS will rise, i.e., proposition S, and Sam has done his homework. Thus, H and R^c are not compatible. We have used Sam's probability space of H to determine DS's probability space for R.

We can use a similar argument to obtain a second estimate over the frame of discernment $\{R, R^c\}$. Suppose that R is true when the value of the Dow rises, representing the latter proposition by D. Assume the Dow goes up 80% of the time; when it does not, it's another random walk down Wall Street. Thus, we have the relationships:

$$\begin{aligned} m_2(\{R\}) &= P(D) = 0.8 \\ m_2(\{R, R^c\}) &= P(D^c) = 0.2 \end{aligned}$$

As before, D is compatible with R but not with R^c ; D^c is compatible with both R and R^c . Using Dempster's rule of combination, we obtain a composite picture of the situation and demonstrate the compatibility relation:

$$\begin{aligned} m &= m_1 \oplus m_2 \\ m(\{R\}) &= 0.94 \\ m(\{R, R^c\}) &= 0.06 \end{aligned}$$

Information on Dempster-Shafer Theory is given in the accompanying paper (Katzan 2010) and in the relevant publications. (Shafer 1976, Dempster 1967, and Katzan 1992)

COMPATIBILITY RELATIONS

This section gives an algorithm for exercising a compatibility relation between focal sets in two information spaces. A belief system can be conveniently conceptualized as a directed graph (G), represented symbolically as $G=\{V,E\}$, where V is a set of vertices and E is a set of edges. The vertices are called *nodes* and the edges are referred to as *links*. The nodes store information that take the form of belief structures. The links represent the relationship between nodes. A *belief system* is a collection of four entities: evidence, nodes, links, and decision scripts.

Evidence

An element of evidence is represented as a simple support function over a frame of discernment and regarded as a "cloud of evidence" that takes the form:

$$e = \{obj_1, obj_2, \dots, obj_n\}, bpa\}$$

where obj_i is an object from the frame of discernment and bpa is a basic probability assignment taken as a measure of belief that a random variable is contained in the belief set. If Θ is the frame of discernment, then $m(A)$ is a measure of belief assigned to a subset A of Θ .

Nodes

A *node* is an abstract structure that serves to hold evidence. In general, there are two types of nodes: those that are linked to the environment and those that are not. Three classes exist:

- *Affector nodes* that obtain their information from clouds of evidence. If the input to an affector node is a single cloud, then that affector node holds a simple support unit. If there are two or more inputs to an affector node, then that evidence is combined using Dempster's rule of combination, and the node holds a separable support unit. An affector node represents an *explicit belief*.
- *Constructor nodes* that exist as internal nodes and have belief propagated to them and also have belief propagated from them. If belief is propagated to a constructor node from two or more nodes, then it is always combined using Dempster's rule. A constructor node represents an *implicit belief*.
- *Effector nodes* that are objects to which external entities are attached, such as with a decision script. An effector node is a means of taking appropriate action if specified conditions are met.

A node may be assigned an initial state and takes the meaning of an explicit belief.

Links

A *link* represents a direction along which belief can be propagated. Consider two frames of discernment Θ^A and Θ^B . Further, assume two corresponding sets of propositions $\{P_j^A\}$ and $\{P_j^B\}$, where $j=1,2,\dots,m$ and $k=1,2,\dots,n$. The relation

$$\Theta_j^A \rightarrow \Theta_k^B$$

denotes a linking of frames Θ^A and Θ^B through a set of rules of the form, **if** p_j **then** p_k for couplets p_j^A and p_k^B from frames Θ^A and Θ^B , respectively.

The set of couplets and a probability assignment of the form

$$r_B^A = (((p_1^A, p_1^B) (p_2^A, p_2^B) (p_3^A, p_3^B) \dots) prob_B^A)$$

is known as a "compatibility relation." Θ^A and Θ^B are not necessarily distinct.

Decision Scripts

A decision script translates a resultant belief structure into a prescription for action. We are going to define an *inference relation* of the form

$$(\text{antecedent, threshold}) \rightarrow (\text{consequent, certainty-value})$$

It should be interpreted as follows: if the *bpa* of the antecedent exceeds the threshold, replace the antecedent with the consequent and compute its *bpa* (i.e., the new *bpa*) as the product of the antecedent's *bpa* and the consequent's certainty-value. For example, consider the inference relation

$$(\{a, b\}, 0.6) \rightarrow (\{c, d\}, 0.7)$$

Thus, antecedent of $\{\{a, b\}, 0.8\}$ would map to a consequent of $\{\{c, d\}, 0.56\}$.

Technical Description

In a compatibility relation, a set of rules of the form

if p_j^A **then** p_k^B

along with a basic probability assignment is represented as

$$r_B^A = (((p_1^A, p_1^B) (p_2^A, p_2^B) (p_3^A, p_3^B) \dots) prob_B^A)$$

Each couplet of the form (p_j^A, p_k^B) denotes that an element p_j^A in Θ^A is replaced by the element p_k^B in Θ^B , denoting the aforementioned mapping from Θ^A to Θ^B .

For example, consider two frames of discernment F_1 and F_2 delineated as follows:

$$F_1 = \{a, b, c\}$$

$$F_2 = \{x, y, z, w\}$$

A focal set defined on F_1 is

$$F_1 = ((a, b), 0.6)$$

Consider the set of rules

if a **then** x
if a **then** y
if b **then** w
if c **then** y
if c **then** z

with a measure of belief of 0.8. This is equivalent to stating the belief that one or more of the rules in the set would hold with a subjective probability of 0.8. The set of rules is expressed as a compatibility relation of the form:

$$r = ((a, x), (a, y), (b, w), (c, y), (c, z)), 0.8)$$

The simple compatibility relation r is applied to the focal set F_1 by replacing each element of F_1 , that is elements a and b , by the set of consequents of all rules in which that element is equal to its antecedent. The process is summarized as follows:

1. For each focal element of F_1 , i.e., a or b , replace it with the second element of all couplets where the first element matches. Thus, a is replaced with x and y , and b is replaced with w , yielding the focal set (x, y, w) over F_2 .
2. Take the product of the probabilities, i.e., 0.6×0.8 , as with Dempster's rule.

The sequence of operations yields the support unit

$$((x, y, w), 0.48)$$

which is the projection of F_1 onto F_2 . QED.

QUICK SUMMARY

1. This paper is intended to supplement the companion paper entitled *Group Association Using Identity Analysis* in the area of compatibility relations, which is the mapping between two frames of discernment.
2. Introductory material on identity and belief is covered.
3. A technical description of uncertainty theory is given.
4. Compatibility relations as they apply to identity analysis are described.
5. Subordinate topics are covered including evidence, nodes, links, and decision scripts is covered.
6. Numerous examples are given.

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REVIEW AND REFORMULATION OF THE MAXIMUM AVAILABILITY LOCATION PROBLEM

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ABSTRACT

In this paper we show that the maximum availability location problem (MALP) can be reformulated with fewer variables and constraints. Our computational experiments demonstrate that the reformulated MALP (rMALP) solves much faster and also lends itself to more efficient heuristic development.

Keywords: Location problems; emergency medical services

INTRODUCTION

The analysis of the location of Emergency Medical Response (EMR) vehicles has been an ongoing topic of research for over 40 years. Numerous mathematical models have been created to help optimize coverage by utilizing a limited number of resources [1, 6]. Decisions have to be taken in several areas including the location of the Emergency Response Vehicles, the number of resources to be used and the order in which the vehicles are dispatched.

Due to limited resources in many instances response within an acceptable time cannot be guaranteed for all calls within the system. In this regard a number of trade-offs need to be made. For example minimizing overall response times will result in a smaller coverage area. Depending on the area of emphasis, efficacy of a system can be measured in a number of different ways:

- The total response time is minimized
- The total area covered is maximized
- The maximum time taken to respond to a call is minimized
- The number of calls which are covered within an acceptable time is maximized
- The total response time is minimized while ensuring that all calls are covered within an acceptable time

In the literature models are typically classified as deterministic or probabilistic and furthermore static or dynamic. Deterministic models are prescriptive in nature and used to find the optimal location of ambulances to minimize or maximize an objective. Probabilistic models acknowledge the possibility that a given ambulance may not be available when it is called. These types of models provide a way to model uncertainty by either using a queuing framework or via a mathematical programming approach. Several probabilistic models have been used to determine optimal location points for the EMR vehicles. ReVelle and Hogan proposed the Maximum Availability Location Problem [7]. This is a novel extension of the Maximum Coverage Location Problem introduced by Church and ReVelle in 1974 [3]. The MALP addressed one of the primary shortcomings of the several deterministic models proposed at the time where no allowance was made for the probability that EMS vehicles can be busy. It makes explicit provision for the non availability of servers (servers being out on call). In our proposed reformulation of the MALP we show how it can be made more compact and faster to solve with off-the shelf solvers.

THE MAXIMUM AVAILABILITY LOCATION PROBLEM

The classic Maximum Covering Location Problem (MCLP) developed by Church and ReVelle [3] did not address EMR vehicle unavailability. ReVelle and Hogan extended the MCLP to explicitly consider the possibility that when requested an EMR vehicle (e.g., ambulance) may be busy serving an earlier emergency. Therefore they defined the Maximum Availability Location Problem objective as to maximize the population the servers can cover (within a target response time) with a reliability of α . To model the congestion in the system ReVelle and Hogan use the busy fraction defined in the Maximum Expected Coverage Location Problem introduced by Daskin [4, 5]. Let, x_i = number of servers positioned in node (district, zone) i

n = the number of nodes in the system

h_j = demand at node j

m = number of ambulances available

\bar{t} = average service time

$a_{ij} = \begin{cases} 1 & \text{if node } j \text{ is covered by server at node } i \text{ (within response time target)} \\ 0 & \text{if not} \end{cases}$

Then the busy fraction can be estimated by:

$$p = \frac{\bar{t} \sum_{j=1}^n h_j}{24 \sum_{i=1}^n x_i} = \frac{\bar{t} \sum_{j=1}^n h_j}{24m} \quad (1)$$

Once the busy fraction has been determined chance constraints formulated by Charnes and Cooper are used [2]. The chance constraint is

$$1 - p \sum_{i=1}^n a_{ij} x_i \geq \alpha \quad (2)$$

Where α is desired coverage reliability. ReVelle and Hogan solve for the number of servers (ambulances) required to meet (2) above by:

$$\sum_{i=1}^n a_{ij} x_i \geq b \quad (3)$$

$$b = \left\lceil \frac{\log(-\alpha)}{\log p} \right\rceil \quad (4)$$

Therefore each demand area will require at least b servers in order to attain the required level of coverage with reliability.

Let,

$$y_{jb} = \begin{cases} 1 & \text{if } b \text{ servers cover node } j \\ 0 & \text{if not} \end{cases}$$

The objective function in the MALP is to maximize the total demand covered by at least an α level of reliability.

$$\text{Maximize: } \sum_{j=1}^n h_j y_{jb} \quad (5)$$

Subject to:

$$\sum_{i=1}^n a_{ij} x_i \geq \sum_{k=1}^b y_{jk} \quad \forall j \quad (6)$$

$$y_{jk} \leq y_{j,k-1} \quad \forall j \quad (7)$$

$$\sum_{i=1}^n x_i \leq m \quad (8)$$

$$y_{jk}, x_i \in \{0, 1\} \quad \forall i, j \quad (9)$$

Constraint (6) determines if a node is covered by at least b servers. Constraint (7) ensures that a node is first covered once before it is covered twice or thrice and so on. Constraint (8) ensures that total number of vehicles used is not greater than the total number of vehicles available.

Reformulation of MALP

Instead of utilizing y_{jk} we let

$$y_j = \begin{cases} 1 & \text{if node } j \text{ is covered at least } b \text{ times} \\ 0 & \text{if not} \end{cases}$$

Therefore the objective function becomes,

$$\text{Maximize } \sum_{j=1}^n h_j y_j \quad (10)$$

We now rewrite constraint (6) as follows,

$$\sum_{i=1}^n a_{ij} x_i \geq b y_j \quad \forall j \quad (11)$$

$$y_j \in \{0, 1\} \quad \forall j \quad (12)$$

Constraint (10) ensures that node j is deemed covered ($y_j = 1$) only if it is within coverage distance of the required number of vehicles which is denoted by b and the objective function (10) tallies only the demand (population) covered by at least b times. By changing constraint (6) we eliminated the need for constraint (7). In the original MALP the number of nodes j leads to $(2j + 1)$ constraints and the numbers of nodes j and i along with the required number of ambulances b gives us $(i + jb)$ variables. In the reformulated model the number of variables is $(j + 1)$ and the number of constraints $(j+1)$. The reformulation thus saves j number of constraints and $(b-1)j$ number of variables when $b > 1$.

RESULTS AND CONCLUSIONS

In order to compare the original MALP and the revised model we generated a region which is 1024 sq miles in size and is divided in to 256 zones. Each zone is a square, 4 sq miles in size (2 miles by 2 miles). We randomly generated uniformly distributed call (demand) rates for each of the zones. Ten different sets of data were generated. We then proceeded to apply both models to the generated data at different levels of b , resulting in 50 problems. We used LINDO 6.1 to solve the problem.

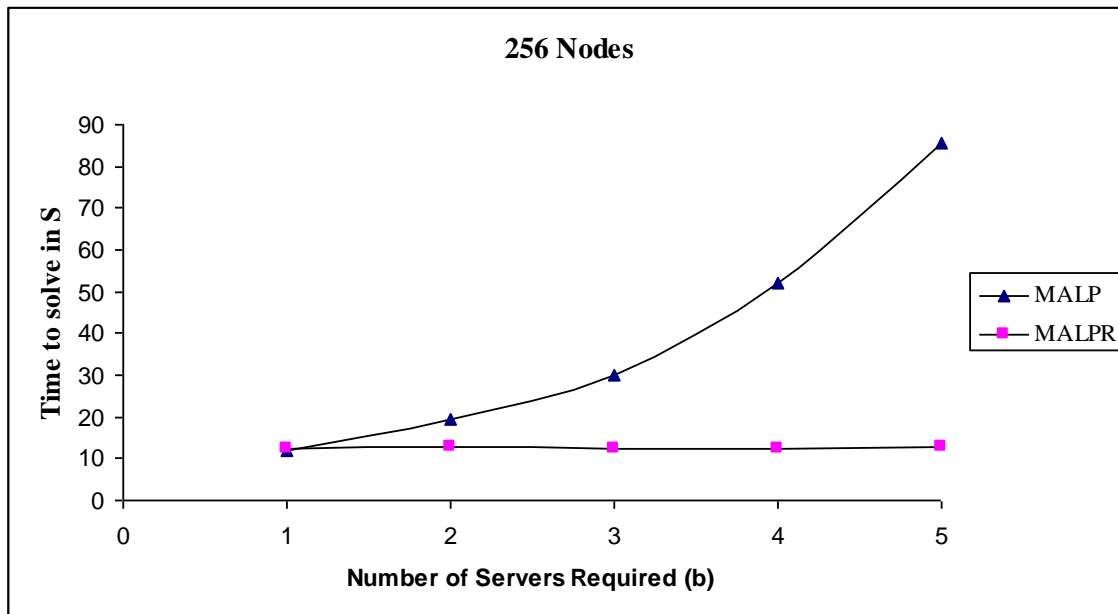


Figure 1. Average CPU times for MALP and rMALP.

The results shown in Figure 1 indicate that the time to solve for the original MALP increases exponentially as the number of required servers increase. The revised MALP utilizes the same number of variables and constraints for all levels of b therefore the average time to solve remains consistent. For problems with a larger number of zones using the revised MALP would result in a significant saving of time without any loss of optimality. To further test this conjecture we are developing large scale problem instances with zones up to 1,024 and using non-uniform distributions to randomly generate call volumes across the (hypothetical) regions.

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Revising Business Statistics to Accommodate the Emergence of Business Analytics

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ABSTRACT

This session will discuss analysis skills necessary to function successfully in a business analytics focused enterprise. Those attending will be asked to assess how well current statistics and analysis classes prepare students with these skills. Discussion will then turn to suggestions for revising the business statistics class. What role should business statistics play in providing students with a breadth of analytical, quantitative and communication skills that are fundamental to business analytics? What needs to be added or given increased emphasis and what can be removed or deemphasized?

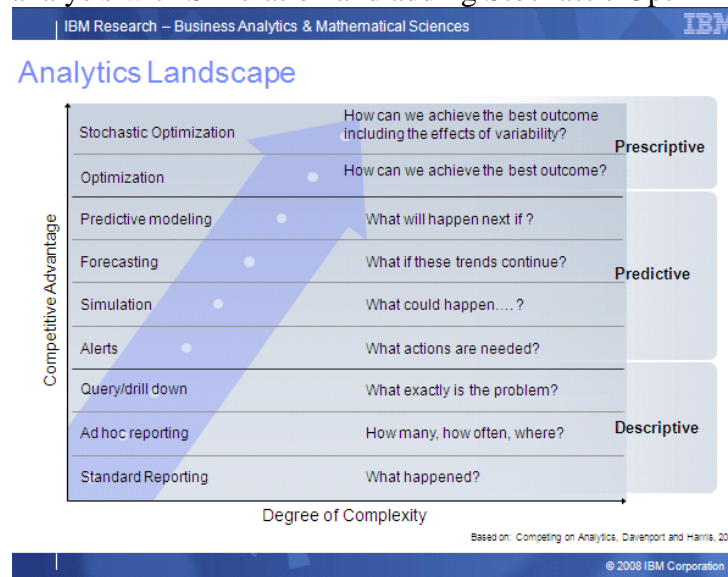
INTRODUCTION AND SESSION OVERVIEW

Since the publication of *Competing on Analytics* by Davenport and Harris in 2007 [1], business analytics has received increased focus and use in the business world. In March 2010 IBM published *The New Value Integrator: Insights from the Global Chief Financial Officer Study* [2] which found that more than 80 percent of the CFOs ranked business intelligence and analytics as their top initiative to enhance company competitiveness. As a result the CFOs expressed a need for employees with business and analytical knowledge to interpret findings and develop relevant advice along with strong interpersonal skills to convincingly communicate recommendations and effectively influence business decisions. They also felt that a significant gap exists between skills required for today's business environment and the skills currently available in the workforce.

In response to a belief that there should be more focus on making decisions based on data in business, health and government areas, IBM has developed a Smarter Planet initiative. In their overview, IBM states, "Data is [*sic*] being captured today as never before. It reveals everything from large and systemic patterns—of global markets, workflows, national infrastructures and natural systems—to the location, temperature, security and condition of every item in a global supply chain. And then there's the growing torrent of information from billions of individuals using social media." [3] These trends of having more relevant data and more reliance on these data for decision making should cause us to examine what we teach in our related business disciplines.

Liberatore and Luo examined the implications of the analytics movement on operations research discipline. They state that "The most profound implication of the analytics movement is its potential impact on education. This impact is not limited to OR; it is applicable to other quantitative disciplines, such as **statistics**, ... and to subject-area disciplines, such as accounting and finance, supply chain management, and marketing." These trends indicate that our current educational process needs to be revised to assure that skills that are being taught match the skills that are needed for those working a business analytics oriented organization.

Figure 1-2 [1, pg. 8] in *Competing on Analytics* provides a set of skills for business intelligence and analytics. In the Analytics Landscape figure below, IBM has altered this diagram slightly replacing Statistical analysis with Simulation and adding Stochastic Optimization at the top.



Last year the decision sciences faculty at Virginia Commonwealth University tried to identify a set of necessary skills for business analytics. After a series of discussions with analytics professionals, including representatives from IBM and Capital One, the following set of skills was developed:

- Work in a collaborative environment.
- Translate a specific business question into a problem that can be solved using appropriate data.
- Acquire and organize appropriate data so that it can be used for analysis.
- Know general principles and common tools and be able to apply them to analyze specific business problems.
- Develop and effectively communicate an actionable solution for the specific business question.

After examining the skills deemed necessary for business analytics, the audience will be invited to enter into a moderated discussion about what should be in the business statistics class. What role should business statistics play in providing students with a breadth of analytical and quantitative skills along with experience in analyzing and communicating solutions to problems arising in a business environment? Should the name be changed from business statistics to fundamentals for business analytics or something similar? What are the things that should be added or given greater emphasis? What are the things that should be eliminated or

deemphasized? How should we treat practical significance? Do we need to shift some of the typical focus on the statistical testing of hypotheses to decision analysis topics?

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Why Upgrade to Office 2010?

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ABSTRACT

This session will provide an overview of the new Office 2010 features to show the improvements over Office 2007. In Office 2007 the relocation of commands to the Ribbon caused a huge learning curve for experienced Office users and many felt switching to 2007 was not worth it. For users who did make the switch then transitioning will be easy with Office 2010 since it has the same “look” as 2007. 2010 does have several worthwhile enhancements. These new enhancements with the same 2007 appearance indicate that making the transition is inevitable. Why not make the transition now to take advantage of these enhancements?

SESSION OVERVIEW

The presentation will give a preview of the new Word and Excel features from Office 2010 and compare similarities and differences between 2010 and 2007. Also covered will be features common to both versions. Participants will be encouraged to interact by asking questions and sharing their knowledge. The goal is to engage those attending and to try to provide information of value to participants.

Office 2010 Fundamentals

Ribbon

There are new features on the Ribbon with Office 2010 but the user interface is very similar to Office 2007. You can now customize the ribbon - create new groups, add commands, remove groups on a tab, reorder commands in a group. And you can import/export the customization to other computers. Adjacent to the Help “?” is a new symbol “^” that will minimize the Ribbon. Right mouse click, select **Customize the Ribbon**.

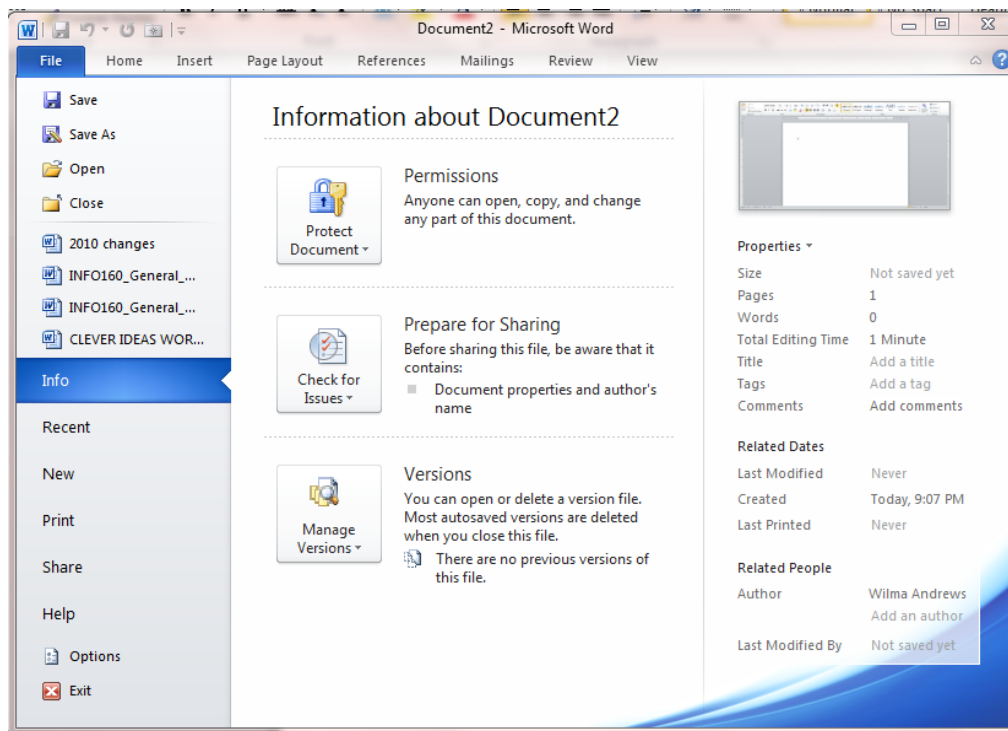
QAT (Quick Access Toolbar)

As in 2007, you can customize the QAT and now there is an option to import/export QAT to other computers as well. An added preset option is **Open recent file** which goes to the same view as the new **Recent** feature from the File tab.

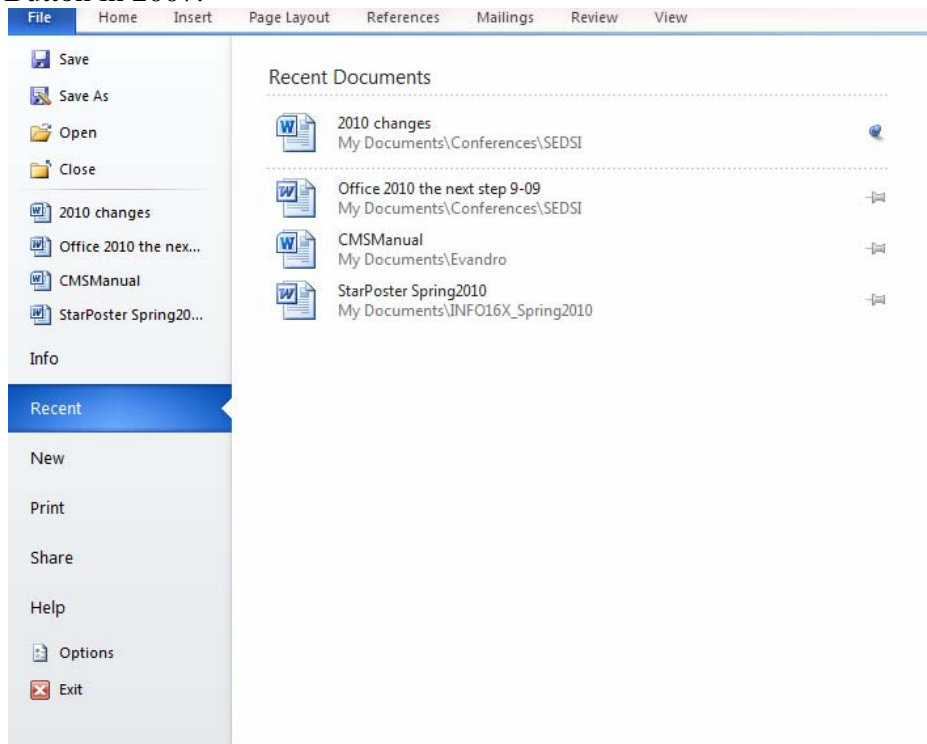
File Tab

The 2007 Office Button has been replaced with the File tab and referred to as the Backstage View where you save, open, print, manage files and control the application options.

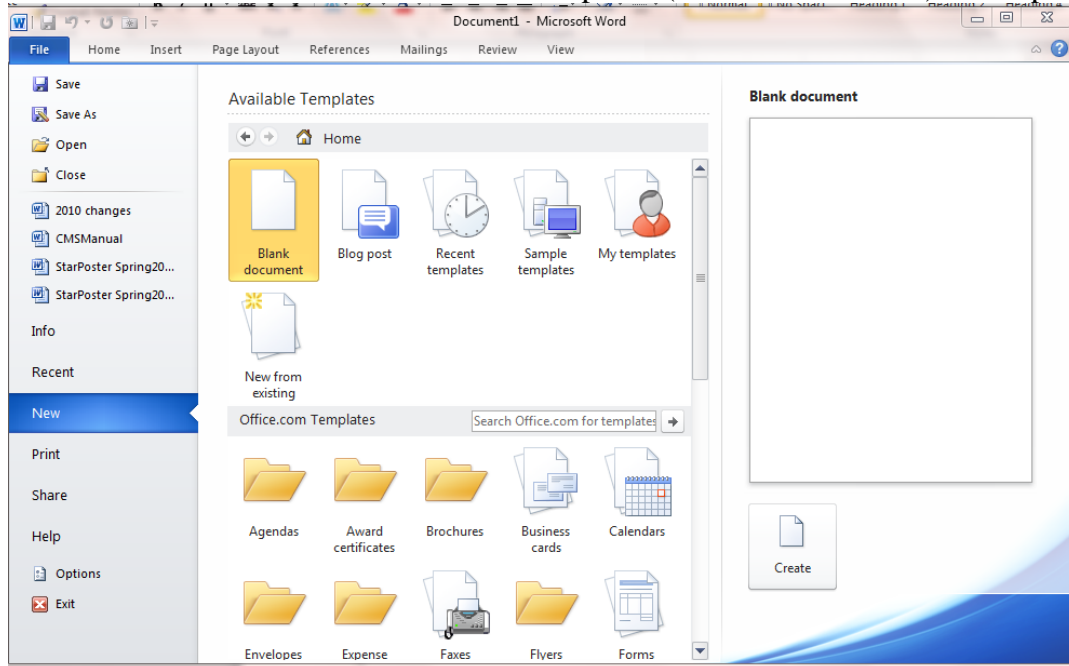
Info is the default view when clicking on the File tab



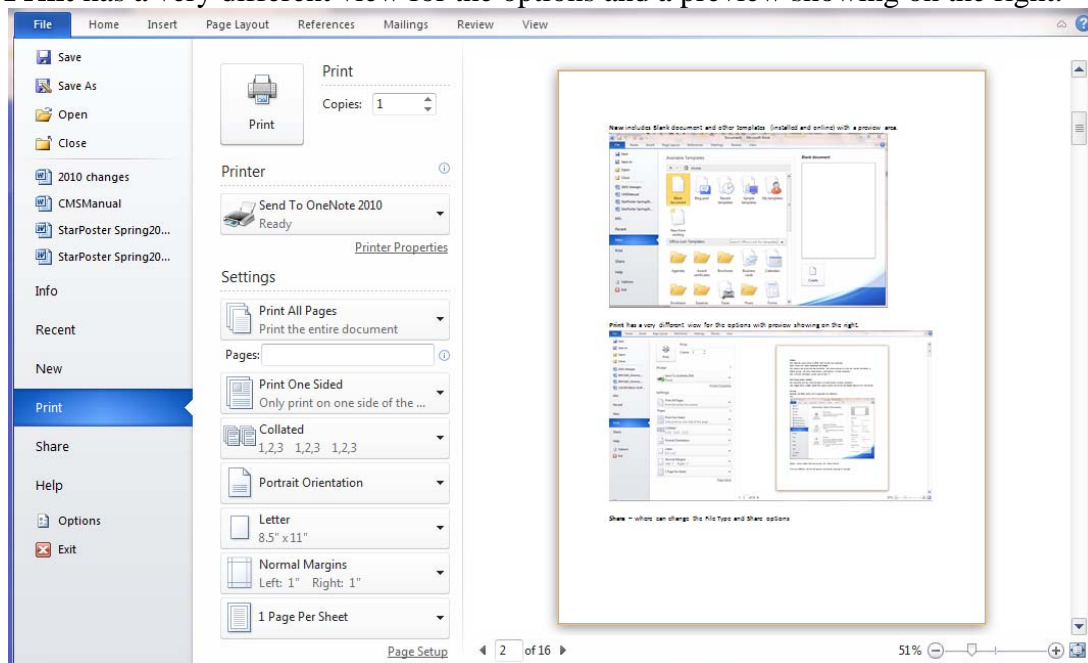
Recent – shows recent files and you can “pin” files to the list as you could with the Office Button in 2007.



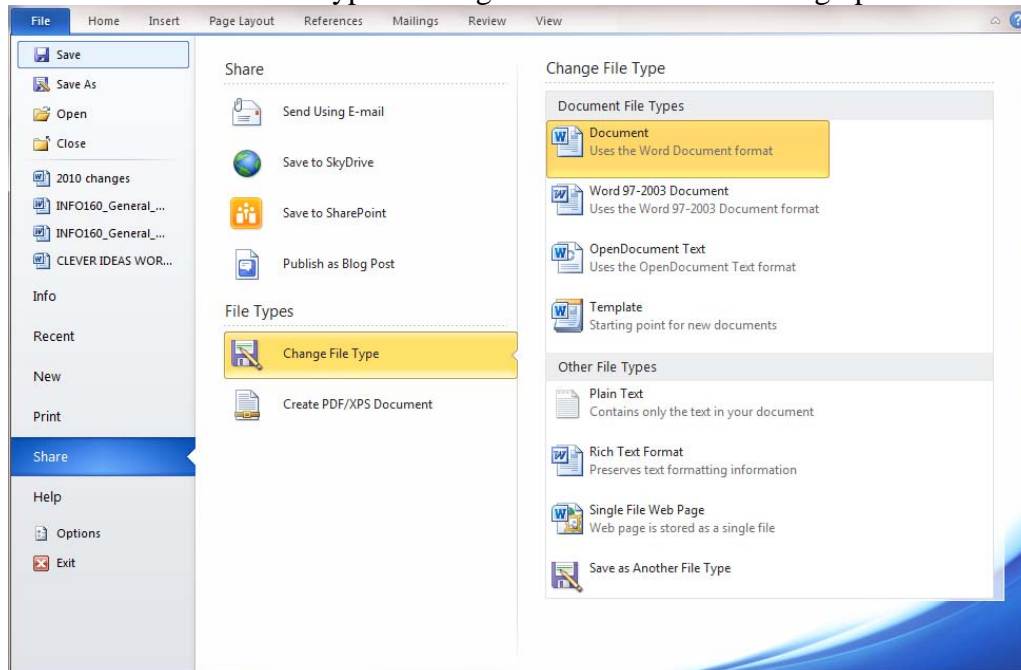
New includes Blank document and other templates (installed and online) with a preview area.



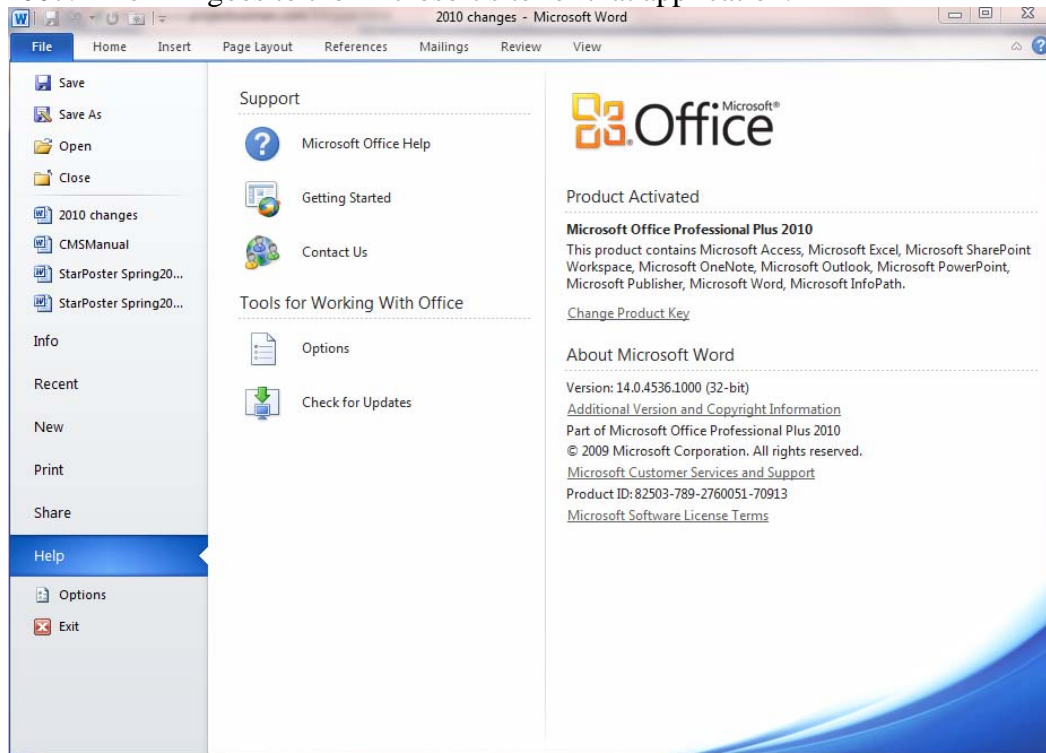
Print has a very different view for the options and a preview showing on the right.



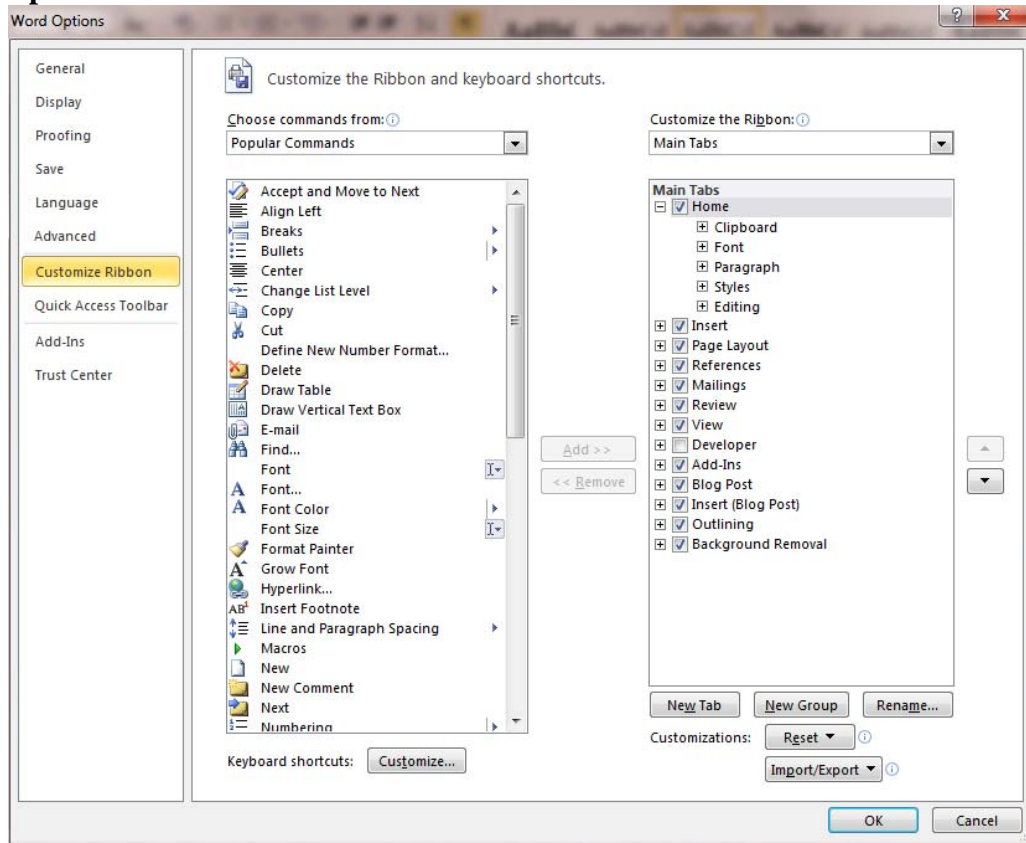
Share is where the File Type is changed as well as other sharing options.



Help has the typical features plus a Getting Started link which replaces the Get Started tab in 2007. The link goes to the Microsoft site for that application.



Options – View is similar to Office 2007 but with **Customize Ribbon** and **Language** added.

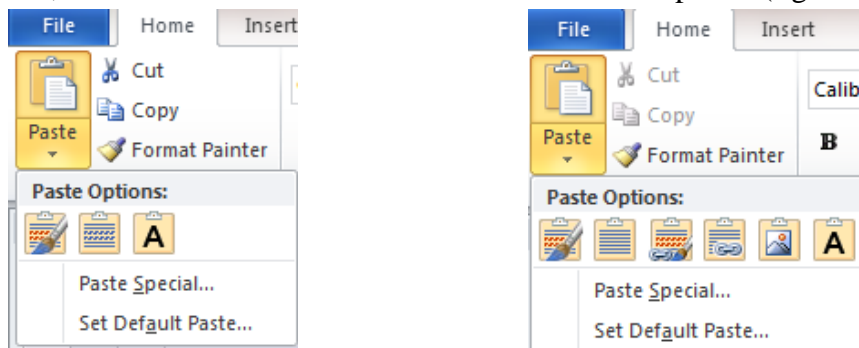


SOME NEW TAB FEATURES COMMON TO WORD AND EXCEL APPLICATIONS

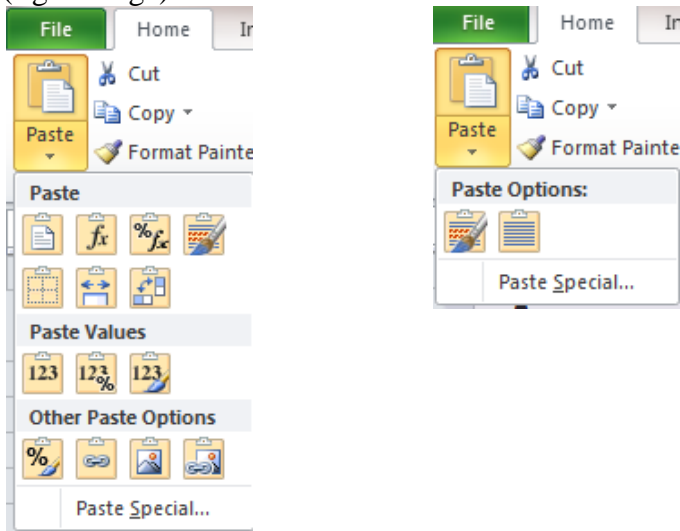
Home tab

Paste – New icons are contextual depending on if the copy is from the application (left image) or from another application (right image).

Word paste options (left image) - Keep Source Formatting, Merge Formatting, Keep Text Only, Paste Special, Set Default Paste. Paste from an Excel source options (right image).

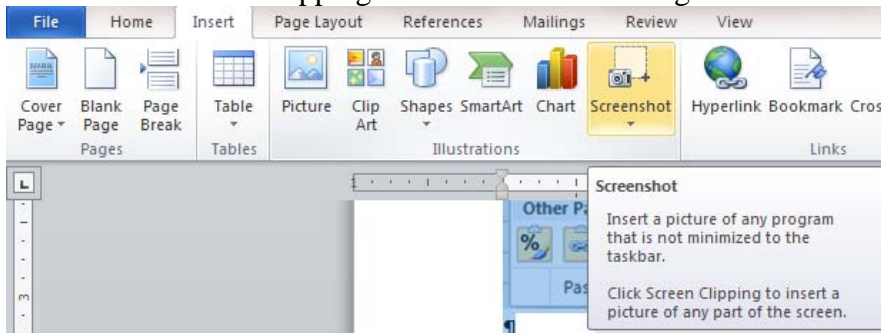


Excel – paste from an Excel source options (left image), paste from a Word source document (right image).

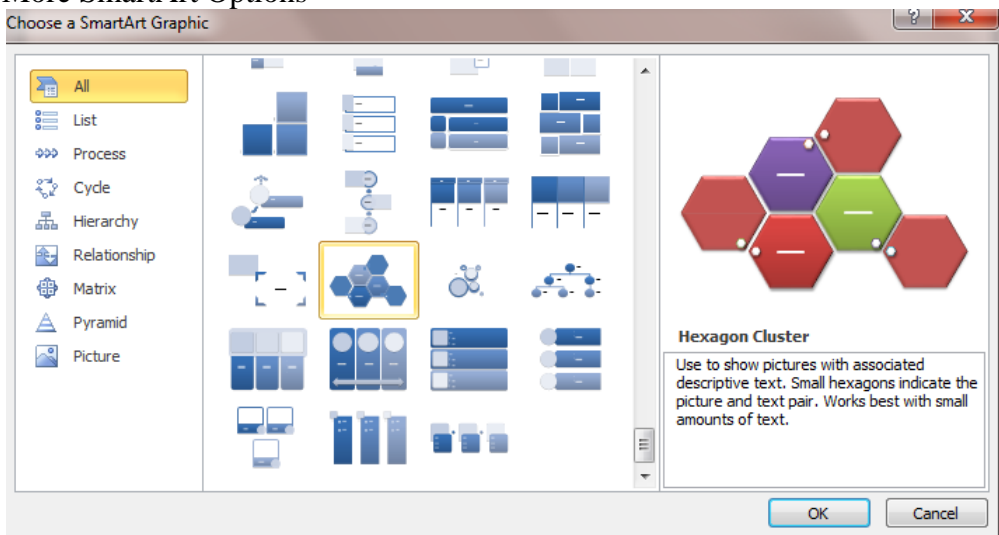


Insert tab

Screen Shot/Screen Clipping – contextual tab of image includes new photo editing features

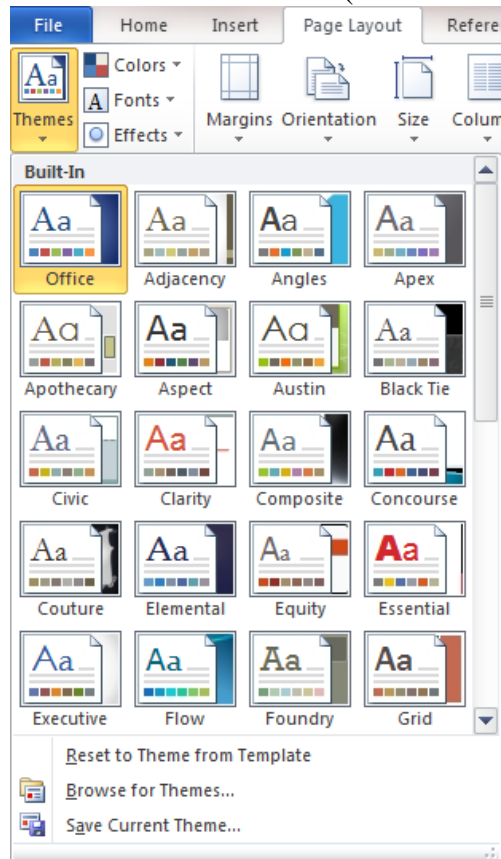


More SmartArt Options



Page Layout tab

Themes – 40 are installed (vs. 20 in 2007) and more are available online.



Office 2010 new features by applications

2010 continues along the trend to provide options for enhancing output and functionality of files.

In **Word**, additional themes and SmartArt graphics have been added to the previous 2007 features. Image editing has been added—as well as additional text effects with OpenType format for scalable fonts. There are new fixed-digit numbering formats. For navigating through a document there are new features at the Navigation pane where whole sections can be moved, searched, or promoted/demoted.

In **Excel**, Pivot Tables have a new feature called slicers which are visual ways to filter data in Pivot tables. Pivot Tables also have improved performance and enhanced filtering. Table enhancements include being able to filter and sort regardless of location within the table. Computational accuracy has been greatly improved. New Solver improvements have also been incorporated. There is a new set of more statistical functions for probability distributions with improved consistency across functions. Sparklines – tiny charts that fit in a cell - provide new visualization capabilities for data. Charting capacity has been greatly expanded allowing for a larger number of data points. Conditional formatting has new icons sets and data bar options. Formulas can now be typed into Textboxes and are no longer restricted to being in a separate image created by the equation editor.

A HOSPITALITY AND TOURISM PROGRAM AS A BUSINESS DEGREE MAJOR CONCENTRATION

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ABSTRACT

In Spring 2009, the Robert Morris University (RMU) School of Business earned its initial accreditation by AACSB International, the Association to Advance Collegiate Schools of Business. To achieve accreditation, the University, School, and business programs had to undergo meticulous internal and external review and evaluation. During a six-year period, the School developed and implemented a mission-driven plan to satisfy 20 quality standards relating to faculty qualification, strategic management of resources, assurance of student learning, and general support for faculty and students. The School also had to validate its commitment to continuous improvement and achievement of learning goals for degree programs. The RMU School of Business offers a Bachelor of Science in Business Administration (BSBA) in seven major concentrations, a Master of Business Administration (MBA), and Master of Science (MS) degrees in Taxation, Human Resource Management, and Nonprofit Management.

One of the seven BSBA major concentrations is Hospitality and Tourism Management. Hospitality and Tourism programs at colleges and universities in the United States function in a variety of academic schools. Only at some institutions of higher education are they housed in schools of business, and only a limited number of those programs are housed in AACSB International accredited schools of business. This paper examines the differences between RMU's BSBA, Hospitality and Tourism Management, and similar programs in non-business schools at other institutions. The paper also discusses the transformation of non-business oriented hospitality and tourism programs into business degree programs and the alignment of such programs with AACSB International accreditation standards.

INTRODUCTION

Robert Morris University is a private, post-secondary institution located in Pittsburgh, Pennsylvania. Geographically, it has evolved from a central city institution to a university with a 200 plus acre suburban campus, a major multipurpose activity complex near that campus, and a central city facility. The institution began as a highly respected local school of accountancy in Pittsburgh, and it grew to become a nationally recognized specialty business college. At the turn of this century, it became a university. The RMU School of Business provides quality education to students from a variety of backgrounds. True to the heritage of the institution, it prepares students for professional careers in business using a practice-oriented approach and experiential learning strategies.

Robert Morris University today has five academic schools: Business; Communications and Information Systems; Education and Social Sciences; Engineering, Mathematics and Science; and Nursing and Health Sciences. Those schools reflect the traditional disciplines taught at the institution and the institutional choice to focus on preparing students for professional careers as it expanded its offerings. The vast majority of undergraduates at Robert Morris University continue their professional careers upon graduation by taking jobs with businesses in the private sector, government or nonprofit organizations.

The Robert Morris University School of Business was granted accreditation by AACSB International in February, 2009. The accreditation was granted after one formal visit by the evaluation team, and the accreditation was granted with several commendations of best practices. The success of the accreditation

followed the School of Business and Robert Morris University's serious adherence to the AACSB recommended multiyear process of consideration and change, formal self-evaluation and consultation, filing of required reports, and final requested to be evaluated and judged.

In that process, the School of Business moved to more coverage of classes by full-time faculty. The School advanced to more formal research and the publication of the results of that research by the full-time faculty. It reduced the number of degrees and the concentrations for degrees offered and made numerous other changes. The School of Business now has 63 faculty members, one undergraduate degree program (the Bachelor of Science in Business Administration), and four graduate degree programs (the Master of Business Administration, the Master of Science in Human Resource Management, the Master of Science in Nonprofit Management, and the Master of Science in Taxation).

The undergraduate degree program – the Bachelor of Science in Business Administration (BSBA) – is offered with a choice of seven concentrations: Accounting, Economics, Finance, Hospitality and Tourism, Management, Marketing, and Sport Management. During the multiyear process of AACSB accreditation, the School of Business reduced its number of degree programs and concentrations. It stopped offering several specialty masters programs, several concentrations available for the MBA, and several Bachelor of Arts and Bachelor of Science degrees. To date, the School of Business has not offered any degree beyond the Masters level.

During the accreditation process, decisions were made to eliminate bachelors and masters degrees in Hospitality and Tourism and a Hospitality and Tourism concentration for the MBA. The decision was made to retain the Hospitality and Tourism concentration for the BSBA, however. That decision and the School's subsequent AACSB accreditation makes the BSBA, Hospitality and Tourism, one of a limited number of degrees in that field offered at an AACSB accredited school of business.

THE ROBERT MORRIS UNIVERSITY EXPERIENCE

In the early 1990's, the School of Business at Robert Morris College negotiated with a nationally recognized academic expert in the field of hospitality and tourism to establish a program of study in the field at Robert Morris College. Dr. Denis P. Rudd brought the discipline to the College and established bachelors and masters degrees in the subject. Consistent with growth at Robert Morris during the later part of the twentieth century, he was charged with recruiting students to the programs and offering courses in the discipline through the use of part-time faculty. Full-time faculty members were to be added to the program as the number of students grew. Dr. Rudd was quite successful.

As the college became a university and as the accreditation process proceeded, the hospitality and tourism discipline grew to three full-time faculty members and it received national recognition. Each of those faculty members conducted research and regularly published results of the research. Among the decisions made during that time of evolution at Robert Morris, it was decided to focus the hospitality and tourism activities on the one concentration for the BSBA degree. The result was that 100% of the coverage of hospitality and tourism classes, based upon the student credit hours taught in Fall 2007 and Spring 2008, were reported as covered by academically qualified faculty in the School's Self-Evaluation Report. [1, pp. 146-7]

OTHER INSTITUTIONS

At other institutions, and undergraduate degree with concentration in any area of hospitality and tourism may be earned in a variety of settings. In many cases post-secondary institutions of education treat hospitality and tourism more as vocational training than business management science. There is a tradition in the field for many workers to be trained for entry level positions, and then to have individuals

gain management training on-the-job or to take formal management training as they rise to positions in management.

Even for colleges and universities that offer degrees in hospitality and tourism, those degrees often are not found in business management curricula. One approach to the hospitality degree is the Bachelor of Arts in Hospitality Management offered online by American Public University. It is a very broadly oriented degree described as:

“This degree focuses on one of the fastest growing industries in the world: hospitality, to include focus areas in food and restaurant operations and management, the lodging industry and operations, parks and recreation management, entrepreneurship, among others. Students in this degree typically have an interest in owning or managing an enterprise or organization in the hospitality industry, but the degree is open to all students and is designed to provide a foundation of research, critical thinking, and writing skills that could be useful in further study and/or professional work.” [2]

The American Public University System is regionally accredited by the Higher Learning Commission of the North Central Association and nationally accredited by the Accrediting Commission, Sistance Education and Training Council.

As a very different example, there is the focused Cornell University School of Hotel Administration. It was the first collegiate program in hospitality management – founded in 1922. Today, its website boasts that “[l]earning takes place in state-of-the-art classrooms, in the on-campus Statler hotel, and in varied industry settings around the world.” It claims “a supremely accomplished alumni group-corporate executives and entrepreneurs who advance the industry and share their wisdom and experience with [their] students and faculty.” [3] In addition, it is accredited as a School by AACSB International. [4]

CONCLUSION

Given the range of possibilities for programs in hospitality and tourism at institutions of higher education in the United States, why does the BSBA, Hospitality and Tourism, fit in the AACSB accredited School of Business at Robert Morris University? It belongs as part of the management degree program because of the faculty, the curriculum, and the students. The faculty are leaders in the teaching, research, and services activities in the School and University. Because of that leadership, they provide academically qualified (defined by the School under AACSB guidelines) for all classes in the concentration. The curriculum, as summarized in Table 1, is a standard curriculum for the BSBA degree. The students complete the management curriculum, interact professionally with the faculty members and professionals in the industry beyond the classroom setting, and in a manner similar to the Cornell alumni they share their wisdom and experiences with students and faculty as they move through their careers.

TABLE 1

School of Business

Robert Morris University

Hospitality and Tourism Management

Curriculum

The 126-credit hour curriculum has six components:

1. **Robert Morris University Core - 42 credits**

These are the traditional liberal arts requirements of the University. Studies in humanities, communications skills, and social, behavioral, natural and quantitative sciences are included.

2. **Non-Business Requirements - 6 credits**

This component consists of required courses in statistics and ethics.

3. **Business Foundations Courses - 27 credits**

These are required of all students earning a B.S.B.A. degree and include courses in accounting, finance, marketing, management and other business administration areas.

4. **Concentration (Hospitality and Tourism Management) - 24 credits**

This is the major field of study, and required courses include an introduction to hospitality and tourism management, food and beverage operations, cost control systems, and marketing and sales.

5. **Business Electives - 12 credits**

Students may select any four courses within the School of Business offerings to broaden their skills in some business area of interest.

6. **Non-Business Electives - 15 credits**

Students may select five courses offered outside the School of Business to broaden their skills in some area of interest.

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THE SCIENCE OF MOTORSPORTS MEETS THE BUSINESS OF NASA

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ABSTRACT

This case study compares and contrasts the business challenges and decision-making styles of two very different organizations. One is a highly visible government agency (NASA) and the other is a highly visible corporation (a NASCAR race team). The focus is on the business factors NASA uses to price its product and the scientific factors a race team uses to evaluate NASA's product.

INTRODUCTION

Decision making is an everyday event in the business of motorsports. Business decisions affect revenue, profit, ROI and investors; and deal with product promotion, customer satisfaction and pricing. Decision making at NASA is all about how to best use the budget voted by Congress to stretch the envelope of scientific endeavor. Revenues, profit, ROI, shareholder value and pricing never come up at NASA. Even the most elementary business fundamentals, such as the customer, customer satisfaction and new product promotion are foreign concepts.

It's hard to imagine two more different organizations with more divergent business models. For example, the motorsports customer drives its business model and every aspect of a race team's business performance. The customer (fan) evaluates the motorsports' "product" and pays for it. NASA has many customers, the scientific community, the taxpayers (its fans), astronauts and so on and each evaluates NASA's products. But NASA's customers don't directly pay for the product; Congress does. This fact situation makes for a very strange and disconnected business model.

This article deals with what happens when a few motorsports teams went in search of a test site to confirm the *science* of their race cars just as NASA was trying to decide how to enter the *business* of marketing and pricing one of its most unique assets, the Space Shuttle Landing Facility (SLF) at the Kennedy Space Center. The science of motorsports comes face-to-face with the business of NASA. NASA now had a paying customer who was evaluating and willing to write a check for a NASA product and its related services.

SITUATION

Although they look and behave entirely different, there are a few notable similarities between the business of motorsports and the business of space exploration. Motorsports has its Indy 500 and Daytona 500, NASA had the Moon 500. The objectives are the same; win the race. The difference is in the number of laps, NASA had one 500,000 mile lap and the space ship traveled at 25,000 mph. NASA replaced the moon rocket with the Space Shuttle, which as the name implies, shuttles equipment, astronauts and supplies in and out of earth orbit.

A few years ago NASA made the decision to retire its fleet of Space Shuttles which made a number of its facilities obsolete. This decision was based on scientific and space exploration goals; not on a market and customer needs analysis. NASA went in search of alternate, commercial uses for 13

payload processing facilities, 140,000 acres of land and its very unique Space Shuttle Landing Facility (SLF).

NASA had a number of business decisions to make but, unlike the typical business owner, NASA was not accustomed to, nor did it have the organization in place to make commercial business decisions. For example, NASA does not have a CEO, a business-savvy leadership team or even a marketing department. Its CFO directorate has no one with pricing experience. NASA's P&L statement lacks revenue and net income lines. The notion of sales, net income and an ROI were uncharted territory.

Other decisions centered around how to manage and staff a commercial enterprise. Who should lead this new NASA business and who should be on its leadership team?

The Space Shuttle is still flying and so decisions had to be made about scheduling and, even more importantly, about how to deal with contingency schedules when a launch date slips.

NASA knew the SLF was a one-of-a-kind product. The SLF is 15,000 feet long (~3 miles), 300 feet wide (length of a football field) and milled to be perfectly flat. (The earth drops off 9 inches every mile but the SLF does not conform to the earth's shape; it's perfectly flat). The SLF also has 2 different surfaces. The middle is smooth and the outer edges are rough. Because of the nature of NASA's work, security is tight; safety is hard wired into the culture and, due to the high risk of launch activity, the Kennedy Space Center is located in a wilderness preserve very near the beach. Rockets take off across the ocean.

NASA's most obvious target market of a shuttle landing facility is a customer needing to take off and land aircraft. For example, the SLF is used to take paying passengers on zero-g flights to experience a brief period of weightlessness. Its not so obvious customer was someone who had no intention of leaving the ground. Once that paradigm was broken NASA opened the door and motorsports walked in. After all, the motorsports industry had experience with testing at government facilities. The Wood Brothers have utilized the wind tunnel at NASA's Langley Aerospace Research Center [1] and teams have tested at the Aberdeen Proving Grounds in Maryland.

DEVELOPING THE PROCESS

Although NASA uses the Shuttle Landing Facility (SLF) to slow down the fastest machine man has ever made. Motorsports needed a facility to allow it to achieve the fastest speed possible on a straight- away. The Indy straight-away is 3,300 feet and Daytona's longer front stretch is 3,800 feet. And so the SLF's 15,000 foot long runway offers plenty of room for a car to stretch its legs.

Wind tunnels are valuable tools but they go just so far. Many wind tunnels are designed to test scaled models and have a static floor; there is only one full scale wind tunnel in the U.S. with 180 mph rolling-road capability [2]. Nevertheless, there's nothing like tires on asphalt and so enter the SLF.

NASA

To undertake the marketing and pricing process, NASA started by designating a Manager of Business Development from its Center Operations Directorate and formed a team representing Finance, Safety, Engineering and the SLF Manager. They then sent out an RFP (Request for Proposals) and received 15 proposals. One of the criteria used by NASA when reviewing the proposals was the linkage between NASA's business and that of the companies submitting proposals. A short list of ten proposals was created, with each of the ten companies invited on-site to determine compatibility with NASA and to see if the facility would meet the company's requirements [4].

One of the successful proposals was from a race team. NASCAR teams were looking for new venues to test their cars since the sanctioning body had banned testing on NASCAR sanctioned tracks. NASA's challenge was how to fairly price a unique asset and thereby ensure a win-win for it and its new customer. NASA benchmarked other test sites frequented by racing teams including the Aberdeen Proving Grounds and the Oscoda-Wurtsmith Airport in Michigan. Both sites featured shorter runways and each charged \$1,500 per day. The SLF is longer, a nicer facility, offers state-of-the-art EMT and fire services, and is more secure; as a result NASA charged \$2,000 per day.

One Race Team's Experience

One of the full time, multi-car NASCAR teams reported that they started using the SLF for testing in mid-2007. There were numerous factors that went into their decision to utilize the facility. There were very few facilities and no good state-of-the art wind tunnels available for straight line, aerodynamic testing. The team used the Maxton WWII bomber training facility in NC but found the facility to be rough and bumpy. The SLF testing facility was very flat and smooth. Since the team competes in Toyotas, they were able to utilize Toyota's proving grounds in AZ for testing, and although the proving grounds has only a 2 1/2 mile straight-away, it is a 10 mile oval which allowed the cars to circle around utilizing both the front and the back stretch straight-aways. The team could test at Toyota's facility free of charge; however the cost of travel was much more significant than taking a van load of employees to FL for testing. In addition, as new, more sophisticated wind tunnels became available, the cost to rent time in these tunnels was also significantly more expensive. A 3-day test at SLF would be budgeted for \$12,000, whereas the cost to test at Wind Shear was approximately \$40,000 per 10-hour shift. Therefore, the SLF was also more attractive from a cost standpoint.

However, there were drawbacks that needed to be taken into consideration when making the decision to rent time at the SLF. The team found it difficult to coordinate booking test time based on the SLF's schedule, the safety features were a bit much, and it was also too short for the type of testing the team wanted to perform. In addition, there was occasionally wildlife roaming on the SLF which created a tremendous hazard at 180+ mph; and, the weather in July was an issue to take into account. The team also found it became more complicated to deal with the logistics of testing since the facility switched general contractors and all of the processes changed.

The team books time at the SLF less frequently since late 2008 and primarily uses wind tunnel testing at this time. The wind tunnel allows more controlled testing resulting in more repeatable, accurate and believable data. In addition, a wind tunnel can be used to test side force, whereas this cannot be tested at an outside facility such as the SLF [3].

SUMMARY

Since 2006, at least six different motorsports teams have used the SLF to wind test its cars in an effort to maximize fuel usage at different speeds with different setups. Each race team comes fully equipped with a machine shop, and equips each car with 6 computers to process and analyze all the data collected. A typical test event starts with a Monday PM set up, testing Tuesday through Thursday and pack up on Friday. They typically bring the whole race team. NASCAR is the heaviest user but one notable IRL (Indy Racing League) team - Andretti Green - rents the SLF three times a year. Three weeks after one of their test sessions, Andretti Green won the Indy 500 with the car tested at the SLF. Nevertheless, demand for the facility has recently declined by nearly 50% due to budgetary cuts within the race teams.

At last check, NASA is doing a brisk business marketing and selling the alternate use of its space assets. Although the Space Shuttle program added three new flights through the end of 2011, there's still plenty of available time to book on the SLF and six new race teams have signed up to use part of that time.

In March 2010, NASA Kennedy Space Center (KSC) held a Commercial Space Transportation Industry Workshop to acquaint attendees with all the features and benefits of KSC's spaceport infrastructure and to discuss ways to use those resources to achieve safe, reliable and low cost access to space.

LESSONS LEARNED

Every race team has one and only one goal, to win. Power, aerodynamics, weight, center of gravity and driver skill combine to make a competitive advantage. Given just that small sample of the variables, the number of permutations is dizzying. Every race team also faces a set of business decisions including where and when to test its equipment given the relative value (price and quality) of each option. As the competitive landscape evolves in motorsports, the techniques used to study these variables and make sound business decisions will also evolve.

NASA is figuring out what it takes to be competitive by improving its decision making processes and business management skills. One notable example is NASA's new web site aimed at commercial customers for its unique set of assets at Kennedy Space Center, (<http://kscpartnerships.ksc.nasa.gov/>). The SLF is one of several physical assets advertised on the site. The web site also lays out the how-to's and frequently asked questions to help potential customers take the first step in doing business with NASA. This is advertising and product promotion, which represent a whole new world for NASA to explore.

Customer satisfaction surveys and capturing the voice of the KSC customer are fast becoming integral parts of the NASA business model. The concepts of revenue, profit and ROI are also creeping into the vernacular. As one NASA executive aptly stated, "it's a brave new world for us to boldly go where no NASA civil servant has gone before."

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Rivers Casino: Effects on Pittsburgh

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Abstract

The key reason for the introduction of casino gaming within the Pittsburgh region is the positive impact that the revenue, in conjunction with the tourism trade, will have on the local and state economies. The Pittsburgh region is an area with many economic problems. Although it has weathered the economic recession relatively unscathed, it has suffered due to losses in its manufacturing base and its traditional steel production. There have been a number of attempts to increase the revenue base of the area including airport expansion, (after 25 years of planning and more than five years of construction, the \$780 million Pittsburgh International Airport terminal opened, providing 24,000 jobs into the next decade), development of a retail market, and an influx of technical companies. These developments have provided a diversified economic base. Pittsburgh is home to some of the largest Fortune 500 companies, including Heinz, U.S. Steel, Westinghouse, PPG Industries, and PNC Financial Services. These companies stretch from downtown Pittsburgh along Route 60 to both the old and the new airports. Yet even with these positive initiatives, welfare and unemployment are still the norm for many Pittsburgh residents. A casino in the Pittsburgh region can provide benefits as well as social and financial risks. Through an extensive and complex process the Rivers Casino was planned developed and constructed in Pittsburgh on the North Shore. This research investigation seeks to determine the impact of the Rivers Casino on the City of Pittsburgh.

Introduction

Gambling has plagued civilizations for centuries and continues to be a controversial issue in today's society. For the city of Pittsburgh, gambling began to impact the city well over 60 years ago with the discussion of whether or not to allow the opening of Pittsburgh's first casino. There were three separate developer groups pushing for their right to be the one to open the new casino. The decision that the city needed to make would not be a simple one. With only one casino permit available within the city of Pittsburgh, the process of selecting the best location and company to be allowed to operate and build the new facility would take months of debates, and a battle for support for each of the three proposed projects.

The three developers had proposed separate locations for the casino within the Pittsburgh region: the North Shore, Station Square, and the lower Hill District. All three proposals had their pros and cons but it was the responsibility of the Pennsylvania Gaming Control Board, established by Gov. Rendell to evaluate the possible positive and negative effects the casino could have on its immediate surrounding area, both for economic purposes and more important the effect on the surrounding communities. It was important for the control board to consider more than just the financial success of the casino options, but to also make a decision in the best interest of the city.

Location

After much deliberation and several delays issuance of the proper gaming license, building permits, and adequate funding, the Rivers Casino started construction in December of 2007 on Pittsburgh's North Shore. The new casino would have 3,000 to 5,000 slot machines, 4 restaurants, and an outdoor amphitheater (Belko, 2009). This past August of 2009, the doors to the Rivers Casino were opened following a few months delays. While the long term impact of the casino has yet to be seen, several immediate effects have been felt within Pittsburgh and its surrounding communities.

Gambling in Pennsylvania is increasingly become a widely accepted form of entertainment and recreation. One of the main reasons for constructing the Rivers Casino was to generate jobs, tax revenue

and economic benefits within the city of Pittsburgh. There are a plethora of economical, social benefits and costs associated with the Rivers Casino Pittsburgh. One of the major reasons for the acceptance of gaming by the state involve the assumption that gamblers would rather gamble locally that out of state, stemming the flow of gambling losses from Pennsylvania's four neighboring states, Ohio, West Virginia, New York and Delaware. Gamblers who live in Pittsburgh will be keeping their money in the city when they gamble at the Rivers Casino rather than spending it in a different city or state.

Keeping the Money

Throughout the casino discussions, the emphasis was upon how the casino can best benefit the city, while not disrupt the already established facilities. Deciding where to put the casino was a much more complex issue for the city of Pittsburgh than obtaining the license. Many Pittsburgh residents did not object to the proposal casino, but no one could seem to agree on its location. With the North Shore was already home to both Heinz Field and PNC Park, many feared that traffic congestion would become even more unbearable (DaPama, 2007). Downtown did not seem like a viable option for a standalone casino. Also, many felt placing it in a low income area, such as the Hill District, would create more problems for a community that did not need any more (Ransom, 2006). Everyone involved felt that this new endeavor would have an impact on the small city. When determining where a slot machine license and casino should be located the Pennsylvania Gaming Control Board decided that the North Shore was the best location for the casino. Out of all the location options, the North Shore was viewed as a less congested location in Pittsburgh, mitigating traffic concerns. The Pittsburgh Pirates and Steelers tried to appeal the casino's location; they believed that bringing a casino into the North Shore would cause high traffic concerns that would affect their sports stadiums. The Pirates and the Steelers eventually came to a consent agreement to devise a plan to mitigate the traffic from the impact of the casino on the sports venues (Colins, 2008).

The community voiced its concern for rising crime rates and risk of gambling addiction among the population these are always significant concerns when introducing a casino in the Pittsburgh region. Introducing the casino to the wrong community might influence people who did not have the disposable income for gambling. These concerns and consideration were deliberations by the Pennsylvania Gaming Control Board, upon deciding where to open the city's new destination casino.

Barden and Neil Bluhm

Don Barden's PITG Gaming LLC was originally awarded the category 2 license for several reasons. Don Barden is the only black casino operator in the United States (WPXI, 2006). The Pennsylvania Gaming Control Board considered it desirable that the company was owned and operated by minorities. The granting of this license was consistent with the Pennsylvania Race Horse Development and Gaming Act, involving minority's ownership in the Pennsylvania gaming industry.

One of the conditions for granting the gaming license to Barden involved the community and the regions development resulting from casino proceeds. Specifically, Barden focused on the funding a number of grants for redevelopment of the Hill District, the Northside Leadership Conference, and the New Hockey Arena.

After Barden stopped construction on the project, Chicago billionaire Neil Bluhm gained approval from the state to transfer the gaming license to a Holdings Acquisition Corp... Eventually, a joint application approval came into effect causing both Don Barden and Holdings Acquisition Corp. to be joint partners of the project. The Pittsburgh Rivers Casino is a \$780 million dollar casino that is primarily financed by Neil Bluhm. There were around fifty sub-contractors involved in the project. Around 85% of those sub-contractors were Pennsylvania-based companies (Colins, 2008). By using Pennsylvania-based contractors, the money spent on the casino was subject to a multiplier effect in the state.

Casino finances new Penguins arena

This joint application caused Holdings Acquisition and Barden to reaffirm the commitments to fund the new arena, and the development in the Hill District and Northside. As a result of those new commitments, the Rivers Casino is scheduled to make annual payments of \$7.5 million dollars for thirty years toward the construction of the new Penguins Arena. The payment for the new Arena will be divided up into two installments per year until 2038: one on April 1st and one on October 1st (Belko, 2009). The Rivers Casino must also make annual payments of \$1 million dollars for three consecutive years to the Northside Leadership Conference. The casino agreed to pay an initial grant of \$1 million dollars to the Northside Leadership Conference after the casino's tenth month of operation. Another condition for the Rivers Casino to make annual payments of \$1 million dollars for three consecutive years for the redevelopment of the Hill District in the City of Pittsburgh (Colins, 2008).

During the development of the Pittsburgh casino, the Penguins, Pittsburgh's National Hockey Team, was considering moving its franchise because of the deteriorating conditions at the 45 year-old, Mellon Arena. In an effort to gain as much support as possible, the Isle of Capri group, offered to finance a \$290 million new arena for the Penguins (Hamill, 2007). While the Isle of Capri did not ultimately receive the highly coveted gaming license, they did create an expectation that the new casino would be the main source of funds in an attempt to convince their beloved hockey team to remain in Pittsburgh. Once the idea of having the new casino as the main source of funding for construction of the new arena for the Pittsburgh Penguins, who otherwise planed to abandon the city. Pittsburgh residents began to realize the positive and real impact that gambling could have on their hometown. Allowing a casino to open in Pittsburgh would ultimately keep their adored team within the city and most importantly not devastate the significant fan base that the Penguins have.

The Pennsylvania Gaming Control Board threatened to fine the Rivers casino if they did not make their scheduled payment for the hockey arena in October of 2009. The Rivers casino avoided any fines and penalties by making a \$2.35 million dollar payment (Belko, 2009).

"The Rivers Casino represents one more step in the transformation of Pittsburgh from a 20th-century industrial city to a green 21st-century city focused on new technologies," said Strada Principal Michael Stern (Hausman, 2009). Built on the site of a former underutilized steel factory, the Rivers casino provides economic expansion along the rivers in Pittsburgh. The casino encourages development of new hotels, mixed use building, entertainment, restaurants, and housing. "We were delighted to take on the challenge of planning and designing a large destination facility and create a new type of amenity for Pittsburgh on a complex but spectacular riverfront site. In the casino, a patron can literally walk from the gaming floor, across the esplanade and amphitheater and onto a riverboat. Nowhere else in the city can you do that."-Strada Principal Michael Stern (Hausman, 2009).

Expectations

The Rivers Casino is not generating as much money as projected. On its opening day, the Rivers Casino had the third most profitable opening day in the state. Only six weeks later in September, the Rivers Casino posted the third lowest revenues out of Pennsylvania's nine casinos (Boren, 2009). Complaints in reviews about the high priced buffet and low returns at the Rivers Casino. "When they start losing players like me, all they're going to have left is the ladies on those penny machines, and that's not going to pay the bills."-Tony Biava (Boren, 2009). Nearby competitors like the Meadows and casinos in West Virginia Mountaineer racetrack and casino, and Wheeling Track and Casino, offer more desirable deals on group incentives and packages. The Rivers Casino competitors also offer cheaper buffets and more buffet specials. The casino returned 91.35 cents of every dollar put into the slot machines in August and 91.67 cents in September. Players feel that Jackpots are more frequent and the returns are found to be higher with the competitors.

The Rivers Casino offers three thousand slots to visitors making them tied with Sands Bethlehem for second place in the state having the most slots. There are traditional reel machines and video slot machines at the Rivers Casino with games like roulette, card games, blackjack, and more (Belko, 2009). The casino currently offers 973 penny machines, 420 two-cent, 348 nickel, 673 quarter, 38 half dollar,

351 one dollar, 85 five-dollar, four \$100, and one \$500 minimum-bet machine (Belko, 2009). The casino also has \$2, \$10, \$15, and \$25 machines. At the Rivers Casino, the house edge is projected to be around nine percent. Pennsylvania Gaming Control Board spokesman Doug Harbach expects the Rivers Casino to be raking in \$425 million in revenue annually (WDUQNews, 2009).

When table games are legalized in Pennsylvania, the Rivers Casino would only consider putting them in if the current 55% tax is lowered. According to the Rivers Casino President Ed Fasulo, the only way for table games to be profitable at the Rivers Casino would be to lower the table game tax to around 20%. The lower rate would help pay for the dealer's salaries, training, and surveillance cameras for the table areas (WDUQNews, 2009).

Despite many failed attempts from entrepreneurs and investors in the past, the City of Pittsburgh has witnessed the grand opening of its first casino, The Rivers through the combined efforts of Don Barden and Holding Accusations. While the idea of a casino usually conveys an image fun and exciting atmosphere, there are also undeniable negative effects on the local community, businesses and surrounding areas.

The Pennsylvania gaming control Board commissioned a report from the financial suitability task force indicating the projected revenue per slot machine, Gross terminal revenue was defined as the gross amount of gaming revenue expected to be generated. That would be the slot Win per day times the number of machines times 365 days in an operating year (the Win is equal to the drop, minus jackpot tickets, minus jackpot payouts, plus hopper fills, (Rudd 2000).

The calculations would be based upon a future year of operation after the facility has had time to refine and stabilize its operations. A stable year captures competition from competitive facilities. There are four competitive casinos within a 100 mile radius. The number of slot machines reported in the applicant estimates was 5000 but actually only 3000 were installed. The average daily gaming revenue per slot machine is the gross terminal revenue divided by the number of slot machines divided by 365 days of operation.

The applicant estimates of the worst terminal revenue and slot machines daily win are similar to the financial suitability task force estimates.

Pennsylvania Gaming Control Board

Report of the Financial Suitability Task Force

Applicant estimates Financial Suitability Task Force Estimates

	Estimated # of Machines	Slot Win Per Day	Gross Terminal Revenue	Slot Win Per Day	Gross Revenue
PITG Gaming	5,000	\$248	\$452,200,000	\$265	\$482,800,000

Key Terms

Gross Terminal Revenue: Gross amount of Gaming Revenues expected to be generated. (Slot Win Per Day x # of Machines) x 365 Days in Operation

Stabilized Year: A future year of operations after the facility has had time to refine its operations. A Stabilized year captures competition from assumed competitive facilities.

Estimated # of Machines: The number of machines reported by the Applicant that it plans to install and have operational in a Stabilized Year.

Slot Win Per Day The average daily gaming revenue per slot machine. (Gross Terminal Revenue ÷ # of Machines) ÷ 365 Days of Operation

Applicant Estimates

Note: In each instance, the Pennsylvania Gaming Control Board Financial Suitability Task Force used a stabilized year. The use of Task Force estimates cannot be used to predict overall total gross terminal revenue from gaming in Pennsylvania. To compile estimate projections for each applicant, the Task Force had to include any potential competition for that applicant. This means possible revenues from applicants that may not be ultimately awarded a license and go into operation were still used to create competition. This results in, essentially, more competition that would actually occur statewide. Simply adding the Task Force figures would produce low and incorrect assumptions of total statewide gaming revenue.

The Pittsburgh Rivers Casino initially installed 3000 slot machines; these are the revised figures for slot Win per day and gross terminal revenue:

	<u>Applicant estimates</u>		<u>Financial Suitability Taskforce Estimates</u>		
	Estimated # of Machines	Slot Wins Per Day	Gross Terminal Revenue	Slot Win Per Day	Gross Revenue
Rivers Casino	3,000	\$248	\$271,560,000	\$265	\$290,175,000

The estimates of slot Win per day by the applicant (rivers casino) of \$248 per machine per day and \$265 per machine per day from the task force are high for new project.

Results

The results for 2009 through August of 2010 are summarized below:

Estimated # of Machines	2009 Slot Win Per Day	2010 Slot Win Per Day
Rivers Casino 3,000	\$153	\$259

The initial estimates for the applicants slot Win per day were significantly higher than the actual results (\$153 versus \$248) and the financial stability task force estimates are (\$153 versus \$265) for 2009. The 2010 actual slot Win per day \$259 is in line with most the applicant estimates any financial stability task force estimates (\$248 And \$265 for slot Win per day. This change represents the growth and maturing of the rivers casino in Pittsburgh.

Future

Rivers Casino announced it has filed a petition to expand its gaming floor from 129,083 square feet to 135,969 square feet. The change would increase total gaming floor size by approximately five percent. Changes to the gaming floor of more than two percent require approval by the Pennsylvania Gaming Control Board (PGCB). Several of the modifications requested are related to the anticipated addition of table games at Rivers Casino later this summer, pending authorization from the PGCB.

It is estimated that Table games at Rivers Casino will bring 458 new and permanent jobs, plus 80 construction positions with the Pittsburgh-based building contractors who are reconfiguring the casino floor. Added economic benefits include the \$16.5 million table license fee and a projected annual tax revenue increase of \$7 million (Rivers Casino, 2010).

Table Games Implementation

Game Type	Number of Games
Blackjack	42
Poker	24
Craps	6
Roulette	3
Three Card Poker	3
Texas Hold'em Bonus	3
Pai Gow Poker	2
Mini Baccarat	2
Big 6	1
Total	86

Andre Barnabei vice - president of human resources for the River Casino stated that they presently have 917 employees 43% female 22% minority and 96% are Pennsylvania residents. Rivers Casino, which opened in August 2009, features new and exciting slots, nine distinctive restaurants and bars, a riverside amphitheater, live music performances, free parking and multiple promotions and giveaways daily. Rivers Casino is one of nine operating casinos in Pennsylvania and employs approximately 1,000 people. Already, more than \$52 million in jackpots have been awarded to slot players there (Barnabei 2010).

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Title: An Analysis of South Carolina's Use of Emerging Technologies for the Remediation of Leaking Underground Storage Tanks

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Abstract

Leaking underground storage tanks (LUSTs) are the nation's primary source of groundwater contamination. In this article, a methodology for evaluating the effect of emerging groundwater remediation technologies at LUSTs is examined. The goal of each remediation approach is to maximize the amount of contamination removed at LUST sites. This study focused on the development of an algorithm to identify the preferred technology for state program managers to use when managing LUSTs. The resulting algorithm compared two emerging, in-situ groundwater remediation technologies: air sparging and bioremediation. The algorithm evaluated data from 274 LUST sites from the state of South Carolina. This algorithm analyzed 176 LUST sites where air-sparging was applied and 98 LUST sites where bioremediation was applied. Specifically, the cleanup effectiveness of each of the two in-situ technologies was examined at the respective LUST sites. A statistical algorithm was developed to test these two technologies at a wide range of groundwater contamination concentrations to determine the efficacy of the model. Results indicated that this approach provides a useful decision-aiding methodology to enable state program managers the ability to compare different petroleum site management strategies. This research also indicated that

statistical theory presents a robust mechanism for managing LUST cleanups because it can assist the users of this model, state program managers, in the utilization of quantitative data to select the most appropriate groundwater remediation tool.

Keywords: Groundwater, Statistics, Leaking Underground Storage Tanks

1. Introduction

Fifty percent of the nation depends on groundwater for drinking water. Leaking Underground Storage Tanks (LUSTs) are one of the most serious threats to America's groundwater. Gasoline stations with these underground storage tanks (USTs) typically have toxic substances like benzene and toluene that can cause cancer and health concerns for people. According to the Sierra Club, "About 680,000 federally-regulated USTs are buried in urban and rural areas across the country" [Sierra Club, 2005b]. Under federal statute and regulations, state agencies are responsible for remediating environmental contamination in accordance with its laws and regulations. Congress engendered the statutory authority to regulate certain USTs in 1984 by augmenting the Resource Conservation and Recovery Act (RCRA) with Subtitle I. RCRA required that the U.S. Environmental Protection Agency (EPA) develop a widespread regulatory program for USTs that store petroleum to protect the environment and human health from UST releases. The EPA Office of Underground Storage Tanks (OUST) was created by Congress to respond to petroleum spills from USTs. The major impetus was groundwater contamination, principally of drinking water.

The remediation of LUSTs is of critical importance. Traditionally, pump and treat groundwater remediation has been used by states to address its LUST sites. The problem various practitioners have found was that at numerous sites this approach

spreads contamination rather than remediating the contaminants. To help address this problem, EPA developed guidance on the use of optional remedial technologies in the mid 1990s [US EPA, 1996c]. For this paper, the authors chose to study two of these emerging tools: air sparging and in-situ bioremediation. Figure 1 depicts the proportion of the technologies that were studied.

Technologies have evolved over the years to address this major groundwater contamination problem. The conventional, more prevalent technologies which have been applied to address this problem are monitored natural attenuation and groundwater pump and treat. According to Koster and Nesrelles, “the use of pump and treat technology has decreased, only being used at 30% of UST sites in 1995 and 12% in 2001” [Koster and Nesrelles, 2008]. Conversely, “air sparging was used at 8% of UST sites and bioremediation was used at 9% of UST sites” respectively in those same years [Koster and Nesrelles, 2008].

There is an increasing focus on the use of these newer technologies to address this national problem. According to a 2004 report by EPA, both air sparging and bioremediation were successful in reducing concentrations of volatile organic compounds at UST sites [US EPA, 2004a]. EPA decided that the UST program should be implemented by the states. States have to increasingly address more LUST sites with less manpower and financial assets. State environmental agencies need a methodology that can assist them in managing LUSTs. Nationally, EPA asserts that at least 113,000 LUST sites remain to be remediated. This research is intended to assist the decision maker in choosing the most effective remediation technology that would be most appropriate for managing existing and future releases from USTs, and protecting public health and the

environment.

2. Background

2.1 The South Carolina Geologic Table

Although South Carolina's geology was not meticulously studied at each LUST site, the authors were aware of the generic geological patterns where the sites existed. This study focused on two of South Carolina's three different geological Regions. These geological Regions were the Coastal Plain and the Inland Region. The Coastal Plain consists of Regions 4 and 8 (see Figure 2). The Coastal Plain is comprised of sand, clays, and limestone [SCDHEC, 2005]. The Coastal Plain aquifers consist of two subcategories. The Upper Coastal Plain is characterized by thin sedimentary units. The Lower Coastal Plain is thicker.

The Inland Region is composed of older rock such as amphibolite. This Region has higher topography [SCDHEC, 2005]. The Inland Region consists of Regions 3, 5, and a portion of Region 8 (see Figure 2).

2.2 Risk-based Corrective Action

In 1995, the South Carolina UST program implemented Risk-Based Corrective Action (RBCA) as its criteria for remediating LUST sites. The American Society of Testing and Materials (ASTM) developed these standards for addressing petroleum spills. EPA has endorsed ASTM's standard for use by the state environmental agencies.

Most states have incorporated RBCA into their environmental corrective action process. The state is responsible for ensuring that environmental corrective action is fulfilled within its jurisdiction. The RBCA process uses a tiered classification approach to address sites based on their relative risk. ASTM's RBCA sequence is guidance for use

at a variety of LUST sites. This helps states to make remediation decisions based on site-specific risk assessments. Figure 3 is a flowchart that describes the ASTM RBCA process in detail [ASTM, 1995].

South Carolina classifies its groundwater impacted LUST sites into three remediation categories: Tier I, Tier II, and Tier III. Sites are classified as Tier I if petroleum is in drinking water wells or in surface water. In addition, if sites pose an immediate, public health threat to the surrounding community, it will be classified as Tier I [US EPA, 2004b].

Tier II sites are those that pose a threat to groundwater or human health in a time frame from 0 to 12 months. Also, drinking water supply wells that are located less than 1,000 feet or a year of groundwater travel distance from the LUST sites are placed in this category. Tier III sites are those that engender a perceived groundwater or human health threat from 12 to 24 months. Also, ecological receptors are placed within the Tier III category [US EPA, 2004b].

3. Methods

3.1 Collection Process of South Carolina Dataset

The data obtained from the state of South Carolina on the LUST Corrective Action Program were imperative to this analysis. The state provided data on each LUST corrective action completed within the state over a seven year period. The data were based on the results of LUST corrective actions undertaken by the South Carolina Department of Health and Environmental Control (SCDHEC) program managers. The data were presented to the authors as the result of a Freedom of Information Act request in December of 2005. The dataset was comprehensive in that it contained a number of

fields. South Carolina's dataset was more complete than that of other states, and electronically available.

A significant contaminant of concern released from LUST sites in the state is MTBE, which was present at the majority of South Carolina LUST sites studied. For each LUST site, the South Carolina dataset provides the facility name and owner, and its location within the state, e.g., northeast or southwest region of the state. The cost of LUST site cleanups in South Carolina ranged from \$40,000 to \$435,000 per site.

It is clear that the contractors who conducted these LUST site cleanups had difficulty estimating the cost of cleanups. For example, contractor bids on these cleanups were as high as \$2.4 million. The number of contractor bids on the individual site cleanups varied from 3 to 14. The duration of the LUST site cleanups was from 6 to 60 months. The LUST corrective actions were initiated as early as 1997, and completed as late as 2004. The dataset also contained the name of the cleanup contractor for each LUST site.

For each LUST site, the dataset also contained the initial mass of the contaminant concentration, and resulting contaminant concentration after cleanup. Also, it listed which of the two cleanup technologies that were applied: Air Sparging or Bioremediation. The dataset also contained the size of the groundwater contamination plume for each LUST site, i.e., length and width of the plume. Finally, the dataset contained South Carolina's Risk-Based Corrective Action (RBCA) ranking of cleanup difficulty for each LUST site.

3.2 Approach to evaluating remediation techniques for LUSTs in South Carolina

The authors chose to analyze 274 LUST sites from the state of South Carolina where either air sparging or bioremediation was applied to address the sites. Of the total 274 LUST sites that were remediated, 176 sites utilized the air sparging technology and 98 sites utilized the bioremediation technology. The objective of the research was to develop an algorithm that would help state program managers identify which of two groundwater remediation technologies, air sparging and bioremediation, would be the most effective.

One of the most important steps taken by the authors was to develop an equation for the effectiveness of a particular cleanup technology at each of the LUST sites. The measure chosen to determine the effectiveness is the percentage of contamination reduction. The effectiveness of the cleanup technology is the initial concentration in parts per million (ppm) of groundwater contamination at a LUST site minus the final ppm of groundwater contamination at a LUST site divided by the initial ppm of groundwater contamination at a LUST site times 100 percent [Ryan, 2009].

Therefore, the equation derived for the effectiveness, E , of the cleanup technology at each LUST site is as follows:

$$E = \frac{Q_i - Q_f}{Q_i} * 100$$

where Q_F = final ppm of groundwater contamination

Q_I = initial ppm of groundwater contamination

Initially, the authors analyzed the normality of the data. This is an important step because you can better understand the dataset by observing whether any patterns are exhibited and whether the data follows a normal distribution. The author used SAS®, an advanced statistical package, to analyze and characterize the dataset. SAS® was able to generate key statistics regarding the normality of the data and graphical illustrations of the data.

Several key statistics were utilized within SAS® to determine whether the two technologies followed a normal distribution at the respective RBCA levels. Procedure (PROC) UNIVARIATE was utilized to generate these key statistics regarding the data normality. After the data was delineated by the RBCA level, the authors proceeded to analyze the data associated with the pertinent cleanup technology (i.e., Air Sparging or Bioremediation). There were three levels of cleanliness that were associated with the RBCA level. The histogram was visually descriptive because it showed that the data did not follow a normal distribution. A histogram was plotted for the remediation technology data which pertained to the LUST sites at the three RBCA levels. An attempt was made to determine whether there was a difference in the mean effectiveness rate for each RBCA level. Nonetheless, the sample size was only large enough at RBCA Level 1 to analyze the difference between the means.

3.3 Statistical modeling

To develop the algorithm, the RBCA ranking of Level 1 was examined. A RBCA ranking of Level 1 constitutes the most serious threat to public health and/or environment. Typically, these are concentrations of chemicals of concern that have been detected in a potable water supply or surface water supply intake. The sampling data for Air Sparging

and Bioremediation for RBCA Level 1 from the population indicates that it was not normally distributed. Since the sampling data has an unknown distribution, then the sampling mean, \bar{X} , would be normally distributed with mean μ and variance $\frac{\sigma^2}{n}$ when the sample size n is large, i.e., $n \geq 30$. This concept is a result of the “Central Limit Theorem” which states the following:

If \bar{X} is the mean of a random sample of size n taken from a population with mean μ and finite variance σ^2 , then the limiting form of the distribution of

$$Z = \frac{\bar{X} - \mu}{\sigma / \sqrt{n}}$$

as $n \rightarrow \infty$, is the standard normal distribution $n(z; 0, 1)$ [Walpole and Myers, 1993].

An investigation of the mean effectiveness rates for Air Sparging and Bioremediation was conducted for RBCA Level 1. Subsequently, an examination was conducted comparing the difference in sampling mean effectiveness rates for Air Sparging and the sampling mean effectiveness rates for Bioremediation. This analysis was possible because there were thirty or more LUST sites at Level 1.

3.4 Analysis Of Data For RBCA Level 1

RBCA Level 1 sites are also the most dangerous and problematic for site managers to address. The algorithm was utilized on Level 1 sites due to the fact that there were thirty or more data points for each remediation technique, thus enabling the utilization of the Central Limit Theorem. The author analyzed 77 Air Sparging applied Level 1 sites, and 42 Bioremediation applied Level 1 sites. These Level 1 sites were analyzed by the authors because of the immediate impact of these sites to the surrounding

environmental and human receptors. Table 1, RBCA Level 1 Summary Statistics, depicts the principal measurements of the data.

The SAS® program was used to test the data for normality. The program utilized the Shapiro-Wilk statistic to test the data for normality. This statistic test assumes the data is normally distributed. When observing the output from the perspective of Level 1 Air Sparging and Bioremediation data, several principal measurements were observed. For both Air Sparging and Bioremediation, the first key statistic that was noted is the skewness measurement. Negative values were observed. A skewness value of zero denotes a normal distribution. The negative kurtosis values indicate the distribution is flat or platykurtic. The computed p values were less than 0.001. These small p values confirmed that the assumed theory of normality should be rejected for the RBCA Level 1 Air Sparging and Bioremediation data. See Table 2 for Air Sparging data, and Table 3 for Bioremediation data. A scatter plot of the Air Sparging applied technology to the RBCA Level 1 LUST sites is depicted in Figure 4 and a scatter plot of the Bioremediation applied technology LUST sites is depicted in Figure 5.

3.5 Comparison Of Mean Effectiveness Rates for Air Sparging and Bioremediation RBCA Level 1 Data

The first objective was to standardize the data for the mean effectiveness rate for Air Sparging and Bioremediation. This conversion was accomplished by the “Z-score”. The difference between the mean and the sample value divided by the standard deviation is called the Z-score. The Z-score indicates how far the data point is from the mean. It indicates the number of standard deviations that a value is above or below the mean. A positive value for a Z-score indicates that the data point is above the mean. A negative value for a Z-score indicates that the data point is below the mean. A standard normal

distribution has a set of Z-scores with mean 0 and standard deviation 1. This can be a useful way to compare sets of data with different means and standard deviations.

In order to compare these technologies, we tested our null hypothesis.

Test: $H_0 = \mu_A = \mu_B$ (i.e., no difference in mean effectiveness rates for Air Sparging and Bioremediation)

μ_A = population mean effectiveness rate for Air Sparging

μ_B = population mean effectiveness rate for Bioremediation

\bar{X}_A = sample mean effectiveness rate for Air Sparging = 69.54030

\bar{X}_B = sample mean effectiveness rate for Bioremediation = 75.71713

σ_A = sample standard deviation for Air Sparging = 30.77638

σ_B = sample standard deviation for Bioremediation = 23.08803

N_A = sample size for Air Sparging = 75

N_B = sample size for Bioremediation = 39

$$Z = \frac{\bar{X}_B - \bar{X}_A}{\sqrt{(\sigma_B^2 / N_B) + (\sigma_A^2 / N_A)}}$$

$$Z = \frac{75.71713 - 69.54030}{\sqrt{(23.08803^2 / 39) + (30.77638^2 / 75)}}$$

$$Z = \frac{6.17683}{\sqrt{(13.66813 + 12.62914)}}$$

$$Z = \frac{6.17683}{\sqrt{26.29727}}$$

$$Z = \frac{6.17683}{5.128086769}$$

$$Z = 1.19223$$

Since $Z = 1.19223$, it is an acceptable range. The region of acceptance, defined by the computed value of the Z-score, indicates that you should accept the null hypothesis. The Z-score associated with 1.19223 means that there is 88.3% probability (Standard Normal Probability Table) that the mean effectiveness rate for Air Sparging and Bioremediation will have approximately the same value. Therefore, we accepted the null hypothesis, H_0 . The null hypothesis states that there is no statistical difference between the mean effectiveness rates for Air Sparging and Bioremediation.

4. Results

One-hundred seventy-six (176) LUST sites utilizing the Air Sparging technology had approximately 72.052% of the contaminants removed. Ninety-eight (98) LUST sites utilizing the Bioremediation technology had approximately 69.718% of the contaminants removed. An algorithm was created, using the data from more than 270 LUST sites in the state of South Carolina. This algorithm will assist other states in evaluating their LUST programs. Now states can use this algorithm as a technical assistance tool to forecast what average level of contaminants will be removed when in-situ groundwater remediation techniques are applied. It also allows state program managers to understand, when utilizing either Air Sparging or Bioremediation technology, that the average level of contaminants removed is nearly the same.

- ***The null hypothesis is accepted.*** There is no statistically significant difference between the mean effectiveness rates of air sparging and bioremediation technology in removing BTEX contaminants from LUST sites.

- ***An algorithm was developed for LUST sites.*** The model can be used by managers throughout the United States that either utilize air sparging or bioremediation technology. For a universe of thirty or more sites, the model will allow them to forecast the following:

- 1) The ability to determine if the distribution of the data is symmetric or skewed.
- 2) The ability to compute the average amount of contaminants removed from each site;
- 3) A confidence level and the intervals for the confidence level for the average amount of contaminants removed.
- 4) The range of cleanliness for the sites;
- 5) The managers will be able to utilize the data to eliminate outliers that are in the data.

Air Sparging Technology

The algorithm documents that for 30 or more LUST sites that utilize Air Sparging remediation, it is estimated that 82% of sites will have between 11.228% and 99.930% of the contamination removed.

Utilizing Air Sparging remediation, the decision maker will have 95% confidence that the average percentage of contamination removed will fall between 67.850% and 76.505%.

Bioremediation Technology

The algorithm documents that for 30 or more LUST sites that employ Bioremediation technology, it is estimated that 85% of sites will have between 12.036% and 99.784% of the contamination removed.

Utilizing Bioremediation, the decision maker will have 95% confidence that the average percentage of contamination removed will fall between 64.352% and 75.084%.

5. Discussion

5.1 Considerations that Could Impact Relative Effectiveness of Air Sparging versus Bioremediation

The algorithm developed indicated that there was no statistically significant difference between Air Sparging and Bioremediation in terms of cleanup effectiveness. In deciding whether bioremediation or air sparging is the appropriate technology for remediation of a particular LUST release, several factors must be considered. The relative effectiveness of each technology will be highly dependent on the particular LUST site conditions.

5.2 Conditions That Will Favor Air Sparging Technology

Air Sparging is effective in removal of Benzene and MTBE from groundwater. Air Sparging is most useful when applied to sites contaminated with VOCs and diesel fuels. Air Sparging is usually not applied at sites with a high water table since VOCs to the surface are more likely. For Air Sparging to be effective, contaminants must be aerobically biodegradable. At most Air Sparging sites, cleanup times are relatively short, typically taking less than two years to achieve performance objectives [Fields, 2002].

Since Air Sparging increases the rate of contaminant migration, it is important to be aware of the potential for migration of VOC-impacted vapor to human and/or ecological receptors at potential levels of concern. The proximity of the site to houses or other buildings is also critical. Also if injected at a high pressure, the zone of hydraulic conductivity can be reduced. If the Air Sparging system is not managed properly, treatment efficiency may be reduced since the plume could be diverted away from the Air Sparging zone of influence.

5.3 Conditions That Will Favor Bioremediation Technology

The application of Bioremediation to LUST sites is also highly site dependent. The groundwater flow rate and path are essential criteria of a Bioremediation system. Groundwater flow should be sufficient to deliver required amounts of nutrients and oxygen in a reasonable time frame. It has become more prevalent to use aquifer tests and computer models to predict remediation time based on oxygen and nutrient rates. Models are also used to evaluate the feasibility of bioremediation at a particular site. During bioremediation of hydrocarbons, the rate of degradation is usually dictated by the supply of nutrients and oxygen. The range of contaminant concentrations that are amenable to bioremediation depends greatly on the proportion of contamination in the water table. Generally, petroleum hydrocarbons are biodegradable. The lighter, more soluble members are typically biodegraded more rapidly than the heavier, less soluble members. Thus, benzene, toluene, and xylenes are more rapidly degraded than two-ring compounds such as naphthalene [Norris, 1994].

Another important aspect of site characterization that is frequently overlooked is site hydrogeology. Since the rate of remediation of petroleum hydrocarbons in saturated materials is nearly always controlled by the rate of distribution of the nutrients and oxygen source, aquifer hydrogeological properties are critical to bioremediation effectiveness. Microbial populations offer an indication of whether it will be effective in reducing petroleum hydrocarbons. In assessing whether site conditions are favorable for bioremediation, factors to consider include the solubility of hydrocarbons, the volatility of the contaminants, hydrocarbon viscosity, contaminant toxicity, soil permeability, soil type, depth to the groundwater, mineral content, and aquifer pH levels [US EPA 2004a].

6. Conclusions

The algorithm developed by the authors can be used by LUST site managers throughout the United States that either utilize Air Sparging or Bioremediation technology. This research provides and demonstrates a methodology for determining the relative effectiveness of Air Sparging versus Bioremediation. The results of this research will allow others to use this methodology to analyze the relative effectiveness of these two technologies for LUST site remediation. In some site-specific situations, Air Sparging will be selected as the best remedy, and in other cases, Bioremediation will be the most appropriate.

LUST site management problems are very difficult, and can benefit from statistical analysis techniques for several reasons. First, LUST site management problems are often very complex because they are site-specific. This governs the potential need for various cleanup alternatives, their possible combinations, and the

resulting effectiveness. Statistical analysis can provide methods for structuring complex LUST problems to show possible courses of action, the outcomes that may result, factors influencing and affected by such outcomes, and the eventual consequences that can occur from the different outcomes. Second, statistical analysis can address the inherent uncertainty associated with LUST site management problems. Decision makers rarely know the initial composition and quantity of BTEX that a LUST release contains. The algorithm will enable managers to more readily address these concerns.

Nonetheless, in addition to the results of the algorithm, State LUST program managers will use other factors in deciding on the best approach to remediating LUST sites. The algorithm provides an assessment of the effectiveness of the cleanup technology. In addition, the State LUST program manager will examine the implementability of the proposed cleanup technology, and conduct a cost analysis in deciding on the remediation alternative. Implementability is a measure of the technical and administrative feasibility of the chosen remediation technology. The cost analysis examines the initial capital investment, and the operation and maintenance costs associated with the proposed cleanup approach. Carefully considering technology effectiveness, implementability, and costs, the LUST State program managers can make the most informed cleanup decision.

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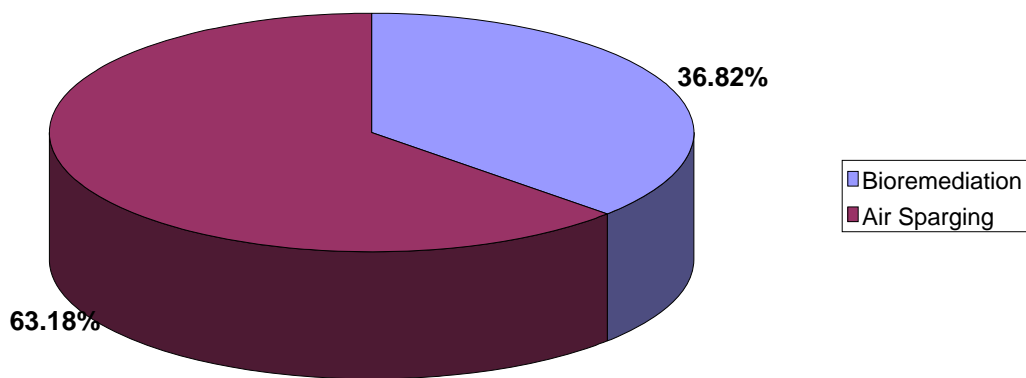


Figure 1.
Proportion of South Carolina's Cleanup Technologies
In-situ Bioremediation vs. Air Sparging

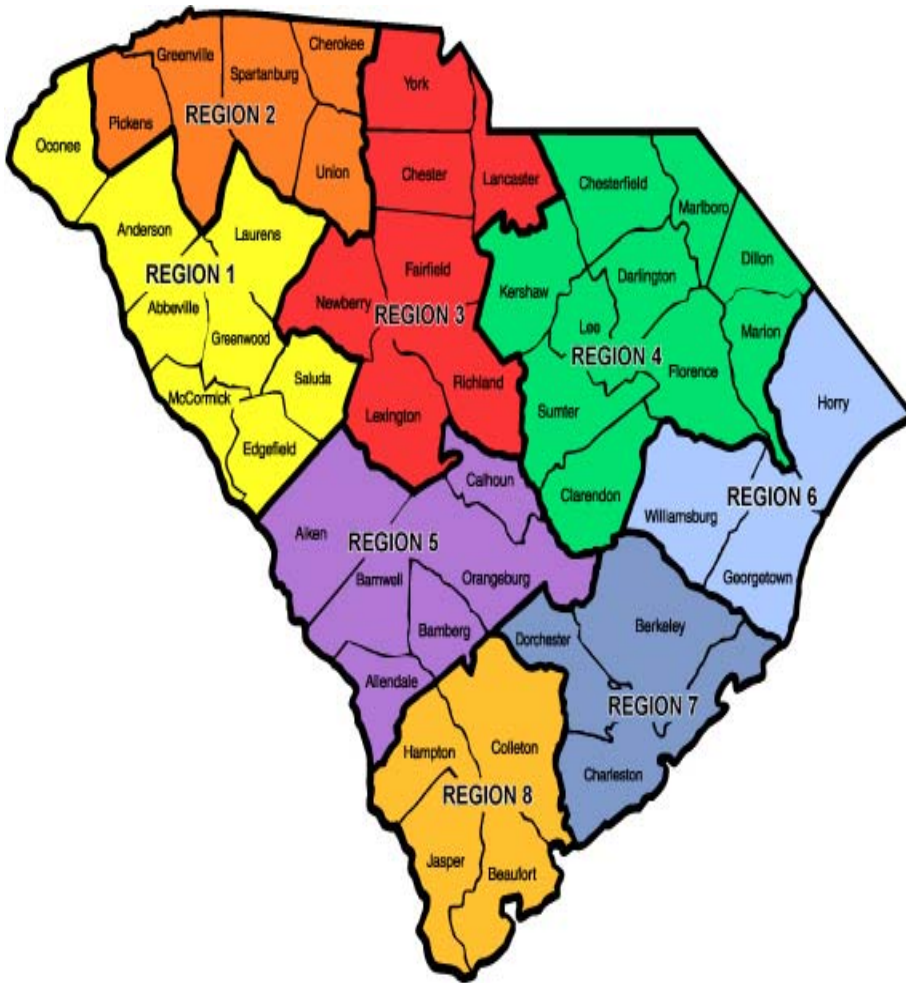


Figure 2. South Carolina Counties
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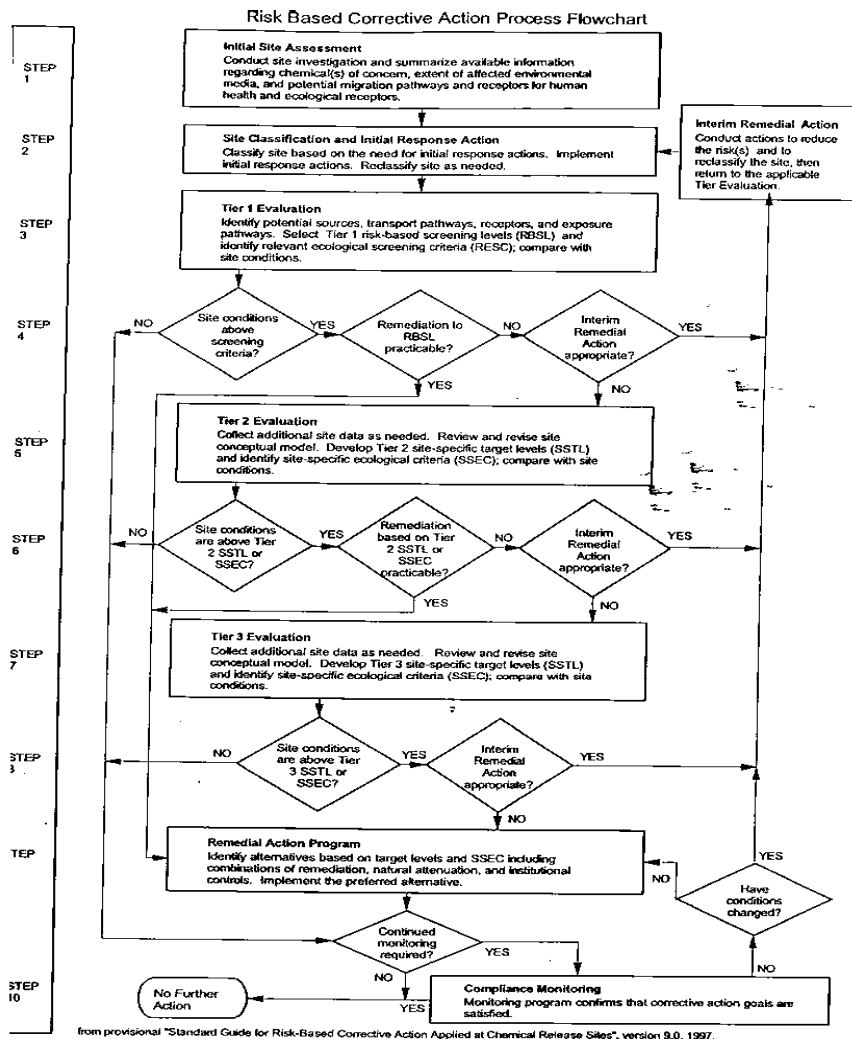


Figure 3. ASTM Risk-based Corrective Action Flowchart
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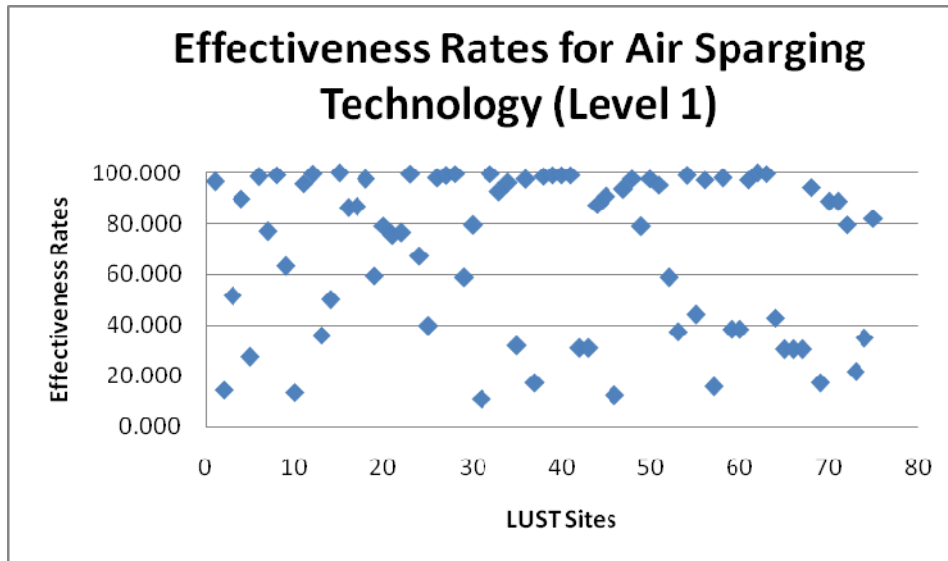


FIGURE 4. SCATTER PLOT FOR AIR SPARGING LEVEL 1 DATA

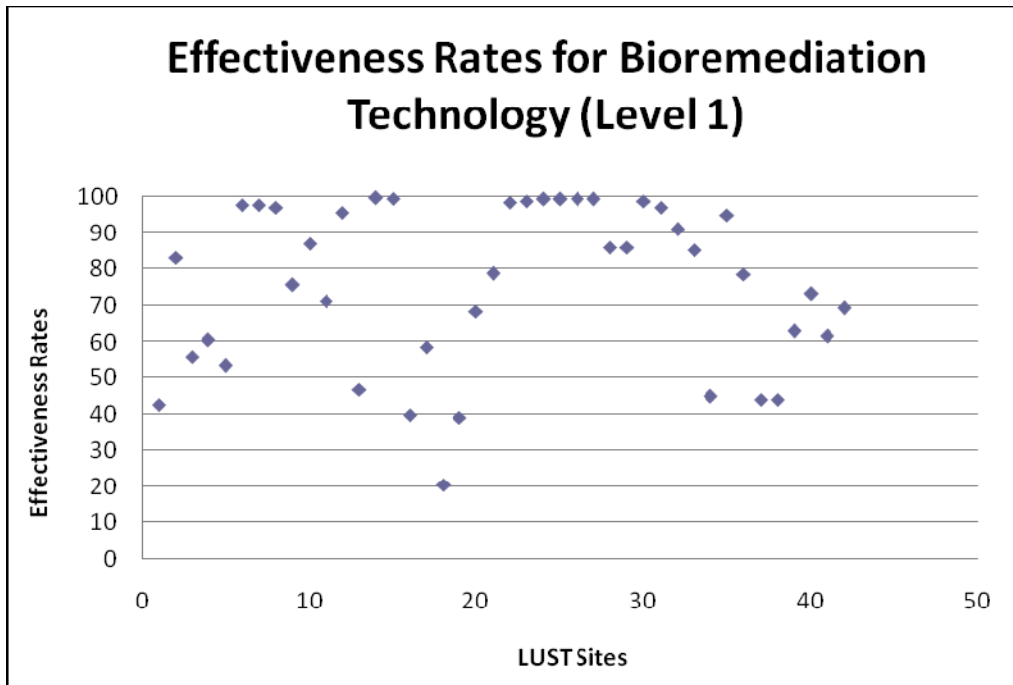


FIGURE 5. SCATTER PLOT FOR BIOREMEDIATION LEVEL 1 DATA

TABLE 1. RBCA LEVEL 1 SUMMARY STATISTICS

Technique	N	Mean Effectiveness Rate	Standard Deviation	Minimum Effectiveness Rate	Maximum Effectiveness Rate
Air Sparging	77	68.099	32.1345	1.43	99.91
Bioremediation	42	75.725	22.5597	20.52	99.78

TABLE 2. KEY STATISTICS PERTAINING TO AIR SPARGING LEVEL 1 DATA

<i>Skewness value</i>	<i>Kurtosis value</i>	<i>Shapiro-Wilk (p) value</i>
-0.5883	-1.214322	p < 0.001

TABLE 3. KEY STATISTICS PERTAINING TO BIOREMEDIATION LEVEL 1 DATA

<i>Skewness value</i>	<i>Kurtosis value</i>	<i>Shapiro-Wilk (p) value</i>
-0.60488	-0.80096	p < 0.001