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ADOPTING THE IS 2009 MODEL CURRICULUM: A PANEL SESSION TO ADDRESS THE CHALLENGES FOR PROGRAM IMPLEMENTATION

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ABSTRACT

This panel session is designed to initiate an open forum and frank discussion of the IS 2009 Model Curriculum proposed by the Joint IS 2009 Curriculum Task Force and developed as a cooperative effort by the Association for Computing Machinery (ACM) and the Association for Information Systems (AIS). Following an introduction to the new model curriculum, a summary and overview of the changes from IS 97/2002 to the IS 2009 recommended core and elective courses will be presented and a panel representing academia and business will address possible issues, challenges, and implications of implementing the suggested curriculum changes on the major stakeholders that include students, faculty, administration, infrastructure resources, and the business community. Concluding the session will be an open forum to allow audience participation in the discussion for the purpose of exchanging ideas on the implementation of the new model curriculum.

Keywords  
IS 2009 model curriculum, ACM, AIS, Implementation challenges, core courses, elective courses, faculty, students, business community, infrastructure resources, curriculum design, IS program.

INTRODUCTION

The evolution of the model IS curriculum development shares a common goal: to provide guidelines for educational institutions to assure their graduates have necessary competencies, skills, and attitudes for success in the workplace and lifelong learning as an IS professional (Davis et al. 1997). The availability of curriculum models not only provides a mechanism to keep the currency of contents for the body of IS knowledge taught, but also provides local academic units with rationale to justify resources to support the IS programs (Gorgone et al. 2003).

1) The systematic approach of model IS curriculum design has several advantages (Davis et al. 1997):
   2) It was based on replicable methodology as the knowledge base evolves;
   3) It provides functional rather than topical guidelines for course content;
   4) the body of knowledge of learning objectives is progressively covered in an integrated fashion;
   5) It provides unified and measurable educational learning objectives, which allows competent learning of the body of knowledge and continuous assessment and feedbacks (Argyris 1976); and
   6) It provides for small learning units and allows both coherent of overall learning outcomes and flexibility for individual academic units to ensure the quality of their graduates.

Both IS’97 and IS 2002 extension have been widely adopted by many IS department as the baseline for their own curriculum design, and have been the basis for IS undergraduate program accreditation (Topi et al. 2009). Despite the rapid contextual and technological changes in information technology in the past 10 years, there have been no major updates of model curriculum and many of the technologies in model curriculum elements haven been quite antiquated. The major changes in technology and industry practices include:

1) A movement towards globally distributed information systems development;
2) Web technologies and development as a core part of IS development;
3) Emergence of service-oriented architecture;
4) Focus on configuration on large-scale enterprise systems;
5) Ubiquitous mobile computing; and
6) Standardization of IT control and infrastructure frameworks (Topi et al. 2009).
Besides the need to reflect technology changes in the curriculum, the enrollment crisis in CS and IS majors also calls for an update in the curriculum design. Since the “dot-com bubble” burst in 2001, IS enrollment decreased as much as 70-80 percent throughout the world (Granger et al. 2007). Even though there are many other factors affecting the IS enrollments, curriculum changes have been recommended by many (George, Valachich, and Valor 2005; Bullen, Abraham, and Gallup 2007; Granger et al. 2007; Kuechler, McLeod, and Simkin 2009) as one of the opportunities to increase enrollment.

On September 11th, 2009, a much anticipated draft version of IS 2009 was distributed by the Joint IS2009 Task Force as the third collaborative effort by ACM and AIS. IS 2009 is considered as a major revision of the existing model curriculum with several significant characteristics (Topi et al. 2009) to address aforementioned issues, including:

1) Reaching beyond the schools of management and business to provide expertise in other domains such as law, biology, healthcare, and so on;
2) The outcome expectations has been articulated in high-level IS capabilities to provide students with skills and knowledge levels in three categories: IS specific, foundation, and domain fundamentals;
3) The curriculum core is separated from electives to support different career tracks; and
4) Involving the global IS community to reflect the global perspective IS discipline.

Compared to previous version, IS 2009 has clearly moved towards a less technical, more managerial focus. It assumes that most organizational systems are built based on packaged systems or out-sourced development. Students are expected to engage in effective communication with both business stakeholders and developers in order to accurately specify both business and system requirements. However, they are not required to understand design and/or implementation of the technical structure of the system. A change in core data management concepts has reduced the focus on physical data modeling and DBA level requirements and application development (IS2002.5 programming, Data, File, and Object Structures and IS 2002.9 Physical Design and Implementation in Emerging Environment). Programming is completely removed from the core set of courses. The other major change in IS 2009 is the infusion of both enterprise architecture and IT infrastructure in core courses, focusing on organizational level issues related to planning, architecting, designing and implementing IT solutions with infrastructure as a foundation.

The proposed new IS 2009 model curriculum has the potential for many challenges to the major stakeholders, including faculty, students, infrastructure resources, administration, business community, and accreditation boards. Before making the transition from the existing IS Model Curriculum to the new IS 2009 Curriculum, many factors (Tatnall and Burgess 2009) need to be taken into consideration, which include:

1) Organizational factors such as organizational constraints and administrative support;
2) Resources such as hardware, software and textbooks;
3) Social factors such as community expectations and competition with other course providers; and
4) Perceptions of faculty members and students towards of the change. Among those diverse challenges, faculty acceptance level towards the curriculum change may be the most critical because faculty members are vital to the strength of an IS program (Topi et al. 2009) and an effective faculty is the first required resource (Firth, Lawrence, and Looney 2008).

PANEL DISCUSSION AND FORMAT

The purpose of this panel session is to initiate a comprehensive discussion of the new IS 2009 Model Curriculum, specifically designed to address issues and challenges of its adoption and implementation. The four-person panel is composed of three faculty members and one information technology business professional. A. James Wynne will provide the perspective of a school of business IS program; Meg Murray will represent an IT/IS program that is housed outside the school of business; Roy Johnson will provide an international IS/IT program viewpoint, and Joe Cipolla will represent the business community’s point of view based on his experience as a former CIO and currently IS/IT Consultant.

The panel session will follow the following format:

- First, a summary of curriculum changes recommended by the task force should be highlighted with an emphasis on suggested major content area revisions;
- Second, each of the panelists will address the implications on their specific program (curriculum) in the short term and the long term, with the business representative providing an employers’ perspective of content appropriateness and focus and expectations of graduates from this program of study;
- Third, a discussion of the implications that these proposed changes will have on major stakeholders including students, faculty, infrastructure resources, administration, business community, and accreditation boards, with a particular focus on faculty acceptance or resistance;
- Fourth, an open discussion forum will provide the audience to address the necessary requirements for transitioning from the existing IS 2002 Curriculum to the new IS 2009 Curriculum.
SUPPLEMENTARY MODEL CURRICULUM INFORMATION

Prerequisite
IS'97.0 Knowledge Work Software Tool Kit (a prerequisite to the program)

A. Information Systems Fundamentals
   a. IS'97.1 Fundamentals of IS
   b. IS'97.2 Personal Productivity with IS Technology

B. Information Systems Theory and Practice
   a. IS'97.3 Information Systems Theory and Practice

C. Information Technology
   a. IS'97.4 Information Technology Hardware and Software
   b. IS'97.5 Programming, Data and Object Structures
   c. IS'97.6 Networks and Telecommunications

D. Information Systems Development
   a. IS'97.7 Analysis and Logical Design of an IS
   b. IS'97.8 Physical Design and Implementation with DBMS
   c. IS'97.9 Physical Design and Implementation with a Programming Environment

E. Information Systems Deployment and Management Processes
   a. IS'97.10 Project Management and Practice.

List 1: Details of IS’97 core curricula (Topi, et.al. 2009)

<table>
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<th>Changes in IS 2009</th>
<th>IS’97</th>
<th>IS 2009</th>
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<td>Foundation topics are changed to more current issues.</td>
<td>IS’97.1: Fundamentals of IS and IS’97.2: Personal Productivity with IS Technology and IS’97.3: Information Systems Theory &amp; Practice</td>
<td>IS 2009.1: Foundations of Information Systems</td>
</tr>
<tr>
<td>From system design and implementation in a DBMS environment to conceptual data modeling, logic models, and physically implementing a relational database using SQL, plus basic database administration tasks. However, physical data model and DBA level requirements have been reduced.</td>
<td>IS’97.8: Physical Design &amp; Implementation with DBMS</td>
<td>IS 2009.2: Data and Information Management</td>
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<td>It does not require in-depth skills in designing or configuring hardware and software solution; instead, focus is on the level required for effective work as business system analysis. It is considered as foundation for further study in more technical issues in computer architecture and communication networks.</td>
<td>IS’97.4: Information Technology Hardware &amp; Software and IS’97.6: Networks &amp; Telecommunications</td>
<td>IS 2009.5: Information Infrastructure</td>
</tr>
<tr>
<td>Focus has changed from object-oriented analysis and logic design to business requirement and system requirement analysis, and high-level design specifications. Also, the assumption is that most organization systems are built based on packaged systems or implemented by using outsourced capabilities (on or off-shore). Specification regarding methods and approaches is left to the individual institution to make the decision based on their faculty capacities and local companies’ need.</td>
<td>IS’97.10: Project Management &amp; Practice</td>
<td>IS 2009.4: IS Project Management</td>
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Instead of system development management or enhancement projects, IS 2009 does not specify system development. Instead, it is considered as all IS projects. Further, team activities are emphasized. It also acknowledges that project management involves not only internal resources, but also external resources (contracted from outside organization). The methods and approaches are left for individual institute to make local decisions.

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<tr>
<th>IS’97.5: Programming, Data and Object Structures and IS’97.9: Physical Design &amp; Implementation with a Programming DBMS</th>
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### Table 1. IS’97 Model Curriculum Courses vs. IS 2009 Model Curriculum Courses. (Topi, et.al. 2009)

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<th>Student Groups Curriculum Model</th>
<th>Student Groups Curriculum Model</th>
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<td><strong>All Students</strong></td>
<td>IS 2009.1 Foundations of Information Systems</td>
</tr>
<tr>
<td><strong>IS Majors and Minors</strong></td>
<td>IS 2009.7 IS Strategy, Management &amp; Acquisition&lt;br&gt;IS 2009.3 Enterprise Architecture&lt;br&gt;IS 2009.2 Data and Information Management</td>
</tr>
<tr>
<td><strong>IS Majors</strong></td>
<td>IS 2009.6 Systems Analysis &amp; Design&lt;br&gt;IS 2009.5 IT Infrastructure&lt;br&gt;IS 2009.4 IT Project Management</td>
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### Table 2. Representative IS 2009 Curriculum Design for All Students, IS Minors & IS Majors (Topi, et.al. 2009)

![IS 2009 Core Courses](Figure 1. IS 2009 Core Courses (Topi, et.al. 2009)
REFERENCES


THE CHURCH ONLINE - THE IMPACT OF ONLINE SOCIAL NETWORKS ON CHURCH CONGREGATIONS

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ABSTRACT
This study will investigate the impact of online social networks for church members on those members’ levels of engagement in the life of the church. Specifically, we endeavor to determine how and whether social networks for the church, including online calendars, discussion boards, blogs, photo sharing, and other such tools might contribute to behaviors such as greater involvement in church activities including worship, small groups, and volunteer leadership roles. Additionally, we will examine whether use of such tools also contributes to higher levels of giving, either to specific requests or to the routine fund raising of the church. Research hypotheses and a research methodology are proposed, along with directions for future research.

Keywords
Online social network, church, engagement.

INTRODUCTION
Our objective is to determine the impact of online social networks for church members on those individuals’ levels of engagement and involvement in the church. Specifically, we are interested in seeing how congregational social networks – collections of people connected to each other through congregational relationships – can be enhanced with the new online social networking tools available today. In other words, how might these new and developing tools for social networking contribute to a greater sense of congregational commitment, involvement in congregational activities including worship and volunteer leadership roles, as well as a greater awareness of special needs of individual members? Additionally, we would like to study whether the use of such networking tools may also contribute to higher levels of financial support, either to specific benevolence requests or to the ongoing financial support of congregational ministries.

Many mainstream churches report sluggish growth or decline in total membership, going back at least 40 years (e.g., General Commission on Archives and History, 2008; Lutheran World Federation, 2008). At least in part, this decline is due to the aging of the congregations, and the failure to draw new younger members to rebuild as the congregation ages. Knowing that one fertile ground for these new members is among youth and young adults [the group Prensky (2001) dubbed “Digital Natives”], it seems reasonable to believe that it might be helpful to use online tools and services to attract and engage these individuals, as well as to engage the “Digital Immigrants” (those who did not grow up with technology, but have since engaged with it).

Anecdotal evidence of church leaders’ belief in the potential of technology may be found in the number of churches offering social networking tools as part of their church’s web presence. For example, Ning, a social networking service allowing creation of branded, private social networks, had at least 350 branded social networks that included “church” and one of four major Protestant denominations as part of their keywords (as of February 20, 2009).

Finally, beyond the formal academic and practitioner literature we find significant interest in online social networks among church leaders. Not only are there large numbers of church-based social networks, as noted previously, but there are also active online discussions that allow pastors and other church leaders to collaborate and learn from one another in this area (e.g., CPOnlineAcademy, 2009).

The remainder of this paper is organized as follows: The literature review provides background for prior research in this area, along with development of hypotheses to be tested. A research methodology and research subject selection approach are proposed, along with anticipated conclusions, followed by limitations and directions for future research.
LITERATURE REVIEW AND HYPOTHESES

Numerous authors have written on the subject of church growth and effectiveness, though relatively few in scholarly publications. Many appear to be practitioners with substantial data to support their recommendations, though their works are not peer-reviewed. Callahan (1983), for example, counts the following among his twelve keys for church effectiveness: worship vitality, concrete mission objectives, “significant relational groups”, strong leadership, and high visibility. These “relational groups” are instances of social networks in the pre-Internet, “offline” sense, and could potentially be impacted in various ways through the use of online social networking tools (boyd & Ellison, 2007).

Arn & Arn (1990) provide more specific direction to measure church health, growth, and effectiveness. Such measures include ratios related to revitalization, evangelism, church school, and worship. These measures provide another set of data points that will be used in our study as potential measures of the impact of social networks and other factors.

Churches can be expected to use their social networks to improve the overall engagement of their congregations. Dimensions of this area include, for example, inviting others to participate and serving the community and the church (Winseman, 2007, p. 39). Beyond the church literature, consumer loyalty concepts include such elements as “patronage behavior,” which corresponds to attendance and giving, in the church setting (Dick & Basu, 1994). Djupe combines these two into the concept of “religious brand loyalty,” wherein individuals, by their affiliation, become embedded in dense social networks that help to create a momentum of affiliation that is difficult to reverse” (Djupe, 2000). Djupe was referring to traditional (“offline”) social networks, but the online tools may provide ways to augment that “momentum of affiliation”.

One example of this was offered by a church administrator interviewed in preparation for this study. She reported that she “staggered invitations (e.g., first my own personal friends who I know will be attending anyway, then other personal friends, before the mass ‘all group members’) and had [a] better response” because “members are more likely to say ‘yes’ to an event … if there are already lots of others who have said ‘yes’.” In this way, Facebook’s online invitation and RSVP service served as an evangelism/marketing and attendance-boosting aide.

Large numbers of churches, and certainly those in mainline Protestant denominations, capture a great deal of numeric data about their members and events. These data provide a solid foundation from which to measure impacts of online social networks. Data include worship and church school attendance, leadership roles, membership statistics, small group attendance, youth ministries, and measures of giving and spending activities (e.g., California-Pacific Conference United Methodist Church, 2008). We anticipate leveraging this data collection process to provide data for this research project.

Online services of various types have been postulated to increase both loyalty and total value to the operator of the online service. For example, in banking, Witman & Roust (2008) showed that active users of online banking services were dramatically higher in net monetary value as bank customers, due in significant part to their online banking usage. This usage seemed to motivate the user to conduct more of their relationship with their online banking institution, due to the greater convenience and visibility it provided. Roust and Witman (2006) also showed that active online banking users were more loyal and left their financial institution at lower rates than non-online banking users, due to the switching costs of moving that relationship to another institution. Graeber further notes that, based on a 33 month study, individual active online banking users actually became more valuable over that time period to their institution than did similar users who did not use online banking (Graeber, 2003).

Ellison el al (2007) define a measure of Facebook intensity that involves both metrics for actual use (minutes per day), as well as psychographic questions. Facebook itself (2009) provides metrics for usage and activity on fan pages, including posting quality assessments and fan demographics. One can also derive information about the activity on the page by reviewing user postings, user comments, and similar empirical observations about the posted activity on the page. Ning provides similar features. We will utilize available data from the social network service to create a measure of user engagement on the page, and that measure may vary based on the social network in use by the church.

From the combination of measures of church effectiveness and the anticipated impact of online services flow the following hypotheses:

H1: Church members who are more actively engaged in the use of social networking tools related to their church congregation will be more active with their church congregation. In this case, we will define church activity as a combination of measures of engagement, as noted previously – leadership roles and attendance at worship and small-group meetings.

H2: Church members who are more actively engaged in the use of social networking tools related to their church congregation will be less likely to leave their church congregation.
H3: Church members who are more actively engaged in the use of social networking tools related to their church congregation will, at least in aggregate, increase their levels of giving more so than those who are not as engaged. (Aggregated rather than individual giving levels will likely be used in this study due to the need to protect member privacy and the sensitivity surrounding release of individual giving records by churches.)

The theoretical model is shown in Figure 1, below.

**Figure 1 - Proposed Theoretical Model**

**METHODOLOGY**

We will conduct this study in two phases. The first phase will capture initial data on church member involvement and online community activity, and if possible, historical church member involvement data. This will allow us to make an initial assessment of the impact of the online community on the life of the congregation. Subsequent data collections, six to twelve months later, and beyond, will permit more complete assessment of the impact of the online community. The longitudinal data will allow analysis of the effects of numerous variables, including the use of online social networks, on the interactions of the congregations’ members in the life of the church. The primary unit of analysis will be at the individual member level within a particular church congregation.

Data from church congregations, including demographics, attendance and participation records, and giving records if available, will be anonymized before delivery for analysis. All data will be encrypted as additional security for the privacy of the member information. Social network records will be anonymized and encrypted in a parallel manner, so that data from the social network can be matched to demographic and member information.

While we intend for the data collection process to be unobtrusive to congregation members, so as not to bias their behavior, we do expect to gather some data via limited interviews and e-mail discussions with church staff and volunteer leaders. This data will be captured and analyzed per case-study best practices (Yin, 2003), and will be used to triangulate with the quantitative data extracted from church participation and social network records.

Social network analysis techniques (Knoke & Yang, 2007) may also be valuable in our analysis of user behavior. In particular, identifying which members are more actively connected to other members may provide an additional data point with respect to analyzing switching costs and engagement. Selection of specific techniques will depend on the availability of data and ability to collect the data without compromising member privacy.

There are a variety of social network services in use by churches at the present time. From our informal review of a large number of church sites, these tend to fall into two major categories – church-specific sites and secular sites. Church-specific sites include a service called MemberConnect, operated by Concordia Technology Services, and another service called mychurch.org. MemberConnect provides integration with core church management software, along with a variety of social networking, calendaring, contact management, and other tools for use by church administrators and volunteers, and by volunteer leaders and members of individual groups, while mychurch.org provides a somewhat broader range of facilities, including blogs and Really Simple Syndication (RSS) feeds, while offering less integration with church management tools.

The primary secular networks include Facebook (www.facebook.com), along with targeted networks such as those hosted by Ning (www.ning.com). Data collection from each of these networks will need to be targeted to the capabilities of the administrative tools for the networks, and may require more manual data collection, such as gathering information from the network’s pages about membership in groups, postings, and other similar data.
An example of a church social network site, promoting its prayer ministry, is shown in Figure 2. This particular church uses both Ning and Facebook, leveraging Ning’s more exclusive access model for internal church discussion, and Facebook’s broad reach as a tool for evangelism and outreach.

![Figure 2. Use of social network to promote a church ministry](image)

**RESEARCH SUBJECTS**

We will work with at least three churches, in three different denominations. Our first research subject is an Evangelical Lutheran Church in America congregation in New Mexico. Our second subject is a United Methodist congregation in southern California. Our third subject will be a United Presbyterian congregation, also in southern California. We have chosen these three denominations to get exposure to different church administration models across the denominations, and will seek out churches with diverse congregations to help ensure generalizability of our results. We anticipate the results to be valid and meaningful to other Protestant denominations and perhaps to other branches of the Christian church as well.

**CONCLUSIONS**

Congregations will learn and benefit from this research in a number of ways: First, the ministry of congregations concerns connections – connections internally and connections externally. This research will better help congregations identify and use the tools and technologies which make congregational networks more effective and enduring, thus enhancing congregational mission. Second, this research will assist congregations and congregational leaders in connecting with a younger generation that is very connected and for whom social relationships are routinely grown and maintained online. This research will help congregations explore how they can develop new ways to think about appealing to younger potential members using network strategies.

We anticipate this study will provide insights into the impact of Internet technologies, and specifically online social networks, on the life of church congregations and their members. To the extent that the use of online social networking tools is early in its adoption by churches and church members, the research will help to document the actual effect of these social networks, and will help to guide the adoption and usage of social networks by other churches. We expect that churches new to social networking can use the research findings to plan their initial online launch for greater effectiveness, and that churches already active in social networking can enhance their effectiveness based on information gained from this research.

**LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH**

The proposed study is clearly limited to Protestant churches in the United States, though some of its results may ultimately be generalizable beyond those groups. Due to the very limited direct contact with church members, the study is also limited in
its ability to control for additional variables, including history of church involvement, psychographic factors, etc., but will attempt to mitigate this issue via discussions with church leaders to identify and control for other causative factors for the observed behaviors among church members.

Future research will gather detailed initial quantitative data from at least three church congregations and assess that data relative to the research questions. Follow-on research will gather longitudinal data from the same congregations to assess changes over time, and to attempt to determine the impact of the various independent variables on the dependent variables. Other follow-on activities may include investigation of other Christian denominations, other sizes of churches, and perhaps other faiths as well.

Further exploratory research may reveal additional levels of granularity which can be captured and measured. For example, it may be possible to categorize different types of church activities, such as social, Bible study, spiritual formation, and service. It may then be possible to assess the impact of social networking tools on the different types of activities, and help churches to ensure that their primary mission objectives are being met.

Crumroy, et al (1998, pp. 269-271), in a broad text on the subject of church administration, note the importance of developing volunteer leadership in the church. Another path that we plan to pursue is related to the volunteer effort required to maintain online content. We understand that if information systems do not satisfy their users’ expectations or if users do not find the system useful, users will not continue to use these systems (Bhattacherjee, 2001). As such, continued maintenance and updates of the content for which various administrative volunteers have responsibility is critical to the overall continued use of the social network. Mathieson (2007) offers some insights into the motivations of volunteers to maintain such content (and to do more technical work as well), including their skills and training, their engagement with the organization, their commitment, and their desire to be of service.

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TOWARDS A FRAMEWORK FOR EFFECTIVE USER PARTICIPATION IN NONPROFIT COMMUNITY CONTEXTS: BEYOND USER INVOLVEMENT

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ABSTRACT
In recent years, IS researchers have begun to examine the broader societal impacts of information systems (IS) and technologies. As such, researchers have sought out various approaches to develop the technological capacity of nonprofit and community-based organizations (NCOs). The concept of user participation is gaining increasing attention as a malleable approach to achieve this goal. This paper develops a strategic framework that theorizes user participation in nonprofit and community-based contexts. We conclude with implications for research and practice.

Keywords
Participatory design, nonprofits, user participation, user involvement

INTRODUCTION
A recent trend in IS research concerns the broader societal impacts of information systems (IS) and technologies (Cushman and McLean 2008; Po-An Hsieh et al. 2008; Zheng and Walsham 2008). This trend is tied to the realization that inequality based on technology access and use is a major ethical and social concern in a digital society. While it is clear that private and public sector organizations are benefiting from well-developed information technology (IT) infrastructures, the literature indicates that nonprofit and community-based organizations (NCOs) are hampered by scarce resources, lack of in-house IT staff, and poor technology planning and management (Carroll and Rosson 2007; Kirschenbaum and Kunammneni 2002; Kvasny and Lee 2009; McPhail et al. 1998; Trigg 2000).

In order to ameliorate these disparities, scholars have called for more research that seeks to promote greater social and digital inclusion (Cushman and McLean 2008). However, a central challenge is how to enhance the technological capacity of NCOs in order to enable them to achieve their future vision and goals. In the context of NCOs, user participation seems like an obvious strategy to engage users in the design process.

The concept of participation has long been a central construct in IS theorizing on system design. Over five decades of empirical and theoretical research has linked participation and the closely related concept of user involvement to systems success (Ives and Olson 1984; Kling 1977; Markus and Mao 2004; Newman and Noble 1990; Swanson 1974). Unfortunately, what is meant by participation is often vague. At one extreme users are involved symbolically as objects of the study, whereas at the other end of the spectrum users are substantively involved throughout the development process.

In this paper, we derive a framework that theorizes user participation in NCO settings. In particular, our model describes an approach aimed at developing the socio-technical competencies of NCOs in order to simultaneously strengthen their organizational and technological capacity. Two contributions to the literature are made. The first contribution is to IS participation theory. We further extend IS participation theory by incorporating the principles and practices that are central to the Scandinavian trade-unionist approach. The second contribution is to research and practice. We provide a framework that researchers and practitioners can use to involve resource-weak NCOs in the development process.

BACKGROUND
In this section we provide a brief overview of the NCO context, followed by an overview of IS participation theory. This is followed by a methodological description of PD. In the following section, we integrate the principles and practices of PD into IS participation theory in order to derive a framework that is suitable for user-led systems development in NCO settings.
The Nonprofit community Context

According to Peter Drucker (1992), three functional sectors are necessary for a cohesive digital society: the private (business), the public sector (government), and the social sector (non-profit). Therefore, it is increasingly important for all organizations to have well-developed information technology (IT) infrastructures – shared technology resources that provide the platform for the organization’s information systems and technologies. While private and public sector organizations are benefiting from well-developed and coherent IT infrastructures, NCOs are consistently hampered by scarce resources, lack of in-house IT staff, and poor technology planning and management (Carroll and Rosson 2007; Kirschenbaum and Kunamneni 2002; Kvasny and Lee 2009; McPhail et al. 1998; Trigg 2000). This phenomenon has been coined the organizational divide. The organizational divide is defined as the inequalities between organizations in society that can effectively use information systems and technologies to support their mission and those that cannot (Kirschenbaum and Kunamneni 2002; Robertson 2001).

In the emerging digital society, corporations, foundations, and government agencies that provide funding to NCOs are increasingly expecting NCOs to adopt and use advanced information systems and technologies to support the delivery, coordination, accounting, and improvement of their programs and services. As a result, the survival of NCOs is in part dependent of their ability to adapt to the digital society. The key question then is how to solve the technology transition puzzle. As a starting point, a technology audit of NCOs identified technology cultures as an impediment to the adoption and use of mission-driven technology (Shorters 1999). In order to transition an organization from viewing technology as unnecessary to strategic advantage, Shorters (1999) proposed an approach that would involve and benefit NCOs by helping them understand the potential benefits of mission-driven technology. Therefore, emphasis has shifted from solely building the technological capacity to simultaneously building both the organizational and technology capacity of NCOs. One way to build the self-help competencies of NCOs is to substantially involve them in the design process. In order to theorize the anticipated benefits of substantial participation (i.e., involvement), we draw on IS participation theory.

IS Participation Theory

According to traditional IS participation theory, enhanced systems success is posited to result from three theoretical explanations: the creation of psychological buy-in among participants; (2) the improvement of systems quality by getting the requirements right, and (3) the emergence of relationships among developers and users that shape development outcomes (Markus and Mao 2004). Markus and Mao (2004) revised the traditional IS theory of participation by incorporating the normative literature that exists at the boundary of IS. Informed by participatory action research, the normative literature consists of the Scandinavian (Ehn and Kyng 1987), UK (Mumford and Weir 1979), and North American (Bødker 1991; Schuler and Namioka 1993) approaches to PD.

The revised theoretical model consists of an articulation of the relationship between the actors, participation activities, context, and outcomes. Solutions development and systems implementation success is posited to result from the quality of participation activities, and the quality of social interaction between the designers and users. Although the model addresses the challenges of changing contexts in traditional IS research, the model does not take into consideration the realities that exist in NCO settings. In order to address this limitation, we draw on the Scandinavian trade-unionist approach or PD.

The methodology of Participatory Design

PD is defined as a diverse set of principles and practices aimed at designing information systems, applications, and infrastructures in which designers and users work together in mutually beneficial ways (Greenbaum and Kyng 1991; Schuler and Namioka 1993). PD is different from other approaches in that users have considerable influence in decision making. In addition, there is a central focus on mutual learning between designers and users. Designers learn about users and their everyday work practices. Similarly, users learn about technological possibilities by taking an active part in the design process.

From a lifecycle perspective, three stages are common to most PD research: (1) initial exploration of work; (2) discovery process; and (3) prototyping (Spinuzzi 2005). Recently, a four phase ethnographically-inspired model was derived from extensive fieldwork with 11 NCOs: (1) identifying IT needs; (2) organizing for IT change; (3) learning new IT skills; and (4) creating and sustaining intrinsic motivation (Carroll and Rosson 2007).

PD consists of tools and techniques that have been successfully employed in NCO settings (Carroll and Rosson 2007; McPhail et al. 1998; Merkel et al. 2004). For example, Kyng (1988) derived an approach for resources-weak organizations which consisted of four strategies: (1) sharing stories and conducting workplace visits aimed at establishing the possibility of alternatives; (2) finding models for local work; (3) using future workshops to help people envision new and different uses of technology; and (4) using mockups to support the concrete design of systems.
Merkel et al. (2007) described a three-step process that was derived from the experiences of working with 11 NCOs: (1) understanding the context of use for NCOs; (2) scaffolding problem solving; and (3) encouraging long-term changes in technology management practices. In another example, McPhail et al. (1998) used a future workshop and demos in order to elicit user participation in a NCO.

Problems and Opportunities

Despite the value of its emancipatory and democratic principles, PD is a diverse methodology in which there is no single definition (Muller 2002; Muller et al. 1997; Sanoff 2007). As a result, PD lacks a strong methodological explanation, and implementation varies by attention to quality control and rigor. In order to address this shortcoming, Merkel et al. (2007) emphasized the establishment of trustworthiness. Triangulation and member checking are used to achieve this goal. Triangulation involves the use of multiple sources of data and data collection methods. Member checking is used throughout the development lifecycle in order to limit potential biases. Additionally, Spinuzzi (2005) emphasized three additional criteria that are related to internal integrity: (1) quality of life for workers; (2) collaborative development; and (3) iterative process.

CONCEPTUAL FRAMEWORK

In this section we develop a conceptual framework that theorizes the conditions under which PD interventions are more likely to strengthen the organizational and technological capacity of NCOs (see Figure 1). These organizations tend to be disempowered and unable to participate in the digital society. Therefore, our model includes functional and democratic empowerment as outcome variables.

![Figure 1: User Participation in Nonprofit Community Contexts](image-url)

**Outcomes: Functional and Democratic Empowerment**

PD is based on the Marxist commitment of democratically empowering workers and fostering democracy. Therefore, the dependent variables address the quality of life for workers criterion (Spinuzzi 2005). Empowerment, which is a form of self-actualization, is based on the extent to which participants are able to take control of their organizational and technological futures. Functional empowerment (i.e., change management) is defined as the extent to which users’ socio-technical competencies are enhanced. Functional empowerment relates to the users’ ability to pursue their activities with greater ease. Democratic empowerment is defined as the extent to which users are prepared to take ownership of the technology (i.e. change outcome). Democratic empowerment relates to the socio-technical competencies that users acquire through their direct participation in the development process. Functional and democratic empowerment is enhanced through structured participation activities that support reflection and mutual learning (Dewey 1933).

Proposition 1: Participation activities are related to functional and democratic empowerment.

**Social Interaction**

Social interaction is defined as the quality of the interaction between the designers and users. Involvement in PD requires a significant amount of social interaction between the designers and users. Therefore, the quality and frequency of social interaction is an antecedent to functional and democratic empowerment.
In order to address the second criterion, we emphasize collaborative development, which involves the participants as co-researchers and co-developers (Spinuzzi 2005). The participants’ world consists of the end-users of the systems and their stakeholders. Because of resource limitations in NCOs, the designers’ world consists of the various roles that designers generally occupy. The primary roles consist of change agent, facilitator, or consultant that introduce changes into an environment and studies the effects. However, we emphasize the role of “bard” in NCO settings. A bard is an outsider who summarizes and celebrates the accomplishments of the organization, encourages reflection on their current practices, and provokes an organization to consider how potential technology changes may facilitate their future vision and goals (Carroll and Rosson 2006).

The relationship between the participants and designers is emergent in the sense that the relationship requires constant social negotiation and consensus building (Truex et al. 1999). Successful outcomes are posited to result from the emergence of relationships that bridge the gap between the users’ and participants’ worlds. Studies have shown that negative outcomes result from poor quality relationships between the designers and users (Urquhart 2001). Therefore, we posit that the quality of the social interaction between the designers and participants is related to functional and democratic empowerment.

Proposition 2: The quality of the designers and participants social interaction is related to functional and democratic empowerment.

Participation Activities

IS research makes a distinction between user involvement (the psychological experience of users) and user participation activities (what users do when actually participating). Our model consists of three dimensions of participation: richness of the participation, tools and techniques, and enabling conditions.

Richness of Participation

Richness of participation is defined as the extent to which participants are likely to experience the activities as personally meaningful and consequential. In early writings on user-centered design, Kling (1977) made a distinction between symbolic participation and substantive participation. Alternatively, Mumford (1983) delineated three types of user participation: consultative, representative, and consensus.

Consultative participation is on the lowest end of the spectrum in terms of user participation. Representative participation involves user representatives in the actual design formulation and decision making. In consensus participation, actual users are directly involved throughout the design process and have conservable decision-making authority. Evidence suggests that continual participation at each phase of the design process and the ability to revisit stages enhances the success of the system (Muller et al. 1997). Therefore, consensus and continual participation provides a much more meaningful experience than participating as a source of data and observation.

Proposition 3: Participation richness is related to functional and democratic empowerment.

Tools and Techniques

PD consists of a wide range of tools and techniques (Muller et al. 1997). These tools and techniques are specific in terms of whether they are used in the users’ world, in the designers’ world, or in the third space that exists between the two worlds (Muller et al. 1997). Based on empirical research, those methods and techniques that are used in the intermediate world that seeks to bridge the space between the designers and participants are more appropriate for use in NCO settings (Muller 2002; Muller et al. 1997).

For example, designers can employ scenario-based design (Carroll 2000; Rosson and Carroll 2002) throughout the systems development life cycle. As an alternative or complimentary approach, designers can employ future workshops (Kensing 1987) which are used in the problem identification and clarification, and requirements and analysis phases. Scenarios and future workshops support critical reflection throughout the develop lifecycle, which empowers users. Benefits include developing group insight, obtaining a consensus view, and facilitating IT learning in NCOs (Farooq et al. 2007; McPhail et al. 1998). The cyclical nature of the participation activities support the third criterion, which is an iterative process (Spinuzzi 2005).

Proposition 4: The selection of methods is related to functional and democratic empowerment.

Enabling Conditions

The final dimension consists of enabling or constraining conditions that designers can sometime manipulate to increase participation effectiveness such as location, resource limitations, and technology culture. Muller and Colleagues (Muller 2002; Muller et al. 1997) suggest that the majority of the activities take place in neutral settings. In this hybrid space the
assumptions of the designers and users are open to question, challenge, and reinterpretation. In terms of the scarcity of resources, the emergence of Web 2.0 tools provide flexible and inexpensive environments that are suitable for appropriation by NCOs.

As it relates to technology cultures, Shorters (1999) illuminated four different technology cultures that are present within the nonprofit sector: unnecessary, necessary evil, necessary good, and strategic advantage. The designer’s task is to ensure that organizations are in the strategic advantage category, which is based on the organization’s belief that technology can provide them with a strategic advantage. This task can be accomplished through the selection and use of appropriate tools and techniques.

*Proposition 5: The designer’s manipulation of the enabling conditions is related to functional and democratic empowerment.*

**CONCLUSION**

NCOs exist all around us in the broader communities in which we live and work, making their study especially relevant. However, NCOs tend to be disenfranchised with respect to their strategic use of technology. To counteract the inequities that currently exist in society; we have presented a conceptual framework that theorizes the benefits of substantial and continual user participation in NCO contexts. Our framework is informed by the democratic and emancipatory principles of PD, which aims to support empowerment and user participation. This framework can be used by researchers and practitioners who are seeking to engage NCOs in design partnerships. Finally, we articulated a set of propositions that will be investigated in future research through ethnographies, surveys, and case studies.

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ONLINE LECTURING: SUITABLE FOR ALL COURSES?

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ABSTRACT

Universities worldwide are rapidly embracing online technologies to make their courses more convenient for today’s tech savvy students. Consequently, academics are suddenly met with increased workload and the need to learn new technologies. Thus, to ensure the success and continual use of this new technology, it is important to gauge academics’ acceptance of online lecturing. However, the suitability of online lecturing may not be suitable for all courses.

Building on Davis’s (1989) TAM model and Daft and Lengel’s (1986) media richness theory, this study provides empirical evidence for the effects of perceived usefulness, perceived ease of use and perceived media richness on the academics’ choice to adopt online video lecturing in differing courses.

Keywords

Technology Acceptance Model (TAM), Media Richness Theory (MRT), online lecturing.

INTRODUCTION

With increasing student numbers, changes to student demographics, limitations to room sizes and equipment availability, online lecturing is seen as a response to addressing the changing context of higher education. Many higher education institutions are expanding their investment in e-learning to enhance learning performance, while others are adopting e-learning practices so that they do not fall behind (Govindasamy, 2002; Cheung and Huang, 2005). As a result, approximately 95% of higher education institutions are now utilising some method of e-learning (Pollack, 2003) including course management systems such as WebCT and Blackboard, online discussion forums, podcasts and chat rooms.

The term online lecturing is used in this study to refer to the range of video technologies used to deliver digitally captured lectures in a visual format to an online community. Common examples include the YouTube, iTunes and university branded online video channels to deliver lecture content. Using online lecturing, students can access educational content at their own convenience at any place, anytime. This is particularly useful to students who are unable to attend lectures due to work commitments, illness and distance barriers. The online lectures can also be used to review the course for exam preparations as well as for students to seek clarification if they had fallen behind in the lecture. The success of online video lecturing has seen lectures being delivered on YouTube and iTunes at many leading universities including Duke, Harvard, MIT, University of California, Yale, Stanford and Oxford to name a few.

As online lecturing is being adopted rapidly by universities worldwide, the understanding of the level of academics’ acceptance of these technologies is crucial to its success. Whilst, online lecture delivery may be advantageous/suitable for courses that are heavily content based, the suitability of online lecturing is questionable for practical/hands on courses as online delivery eliminates students’ ability to interact in hands-on activities that was once available in face-to-face lectures (McConnell & Schoenfeld-Tachner 2001). Hence, the focus of this study is to understand whether online lecturing is more suitable for particular courses and/or disciplines. In this study, results from the faculties of business and law (which are heavily information disseminators) will be compared with the more practical/hands-on faculties of science, engineering and the built environment (includes the architecture school).
TECHNOLOGY ACCEPTANCE MODEL (TAM) AND E-LEARNING

Since its introduction by Davis (1989), TAM has been used extensively in studies predicting acceptance of ICT technologies including online shopping, online banking and software applications (Selim, 2003). In TAM, ‘perceived usefulness’ and ‘perceived ease of use’ are hypothesised to be the major determinants of technology acceptance (Davis, 1989; Selim, 2003).

Perceived Usefulness (PU)

In TAM, perceived usefulness is defined as “the extent to which a person believes that using a particular technology will enhance his or her job performance” (Davis, 1989). Academics may perceive online media to be useful as it can help broaden and enrich the students’ learning experience by serving as a more convenient learning platform that can be accessed regardless of place or time differences. Improvement in student performance will be reflected in the lecturer’s achievements in both student grades and student feedback. Existing IS literature has provided extensive support of the significant relationship between perceived usefulness and usage intention (Davis et al., 1989; Zhang et al., 2008; Saeed and Yang, 2008; Lua et al., 2005; Wang et al., 2006; Yi and Hwang, 2003; Lee et al., 2007). It is expected that academics will use online media if they find that these technologies are useful in the completion of their task, thus:

H1: PU will positively influence the lecturer’s intention to use online lecturing

Perceived Ease of Use (PEOU)

In TAM, PEOU is defined as “the degree to which a person believes that using the system will be free from effort” (Davis, 1989). In this study, PEOU refers to how easy the lecturer believes it is to operate these online video channels to record and publish the lecture recordings. Many studies have provided strong empirical support for the relationship of perceived ease of use on usage intention, either directly or indirectly through its effect on perceived usefulness (Yuen and Ma, 2008; Zhang et al., 2008; Yu et al., 2005; Saeed and Yang, 2008; Lua et al., 2005; Wang et al., 2006; Yi and Hwang, 2003; Lee et al., 2007). Some studies have also found that PEOU is a better predictor of intention to use than PU (Lowry, 2002 in Lua et al., 2005). It is hypothesised:

H2: PEOU will positively influence the lecturer’s intention to use online lecturing

H3: PEOU will positively influence the PU of online lecturing

MEDIA RICHNESS THEORY

Media Richness Theory (MRT) developed by Daft and Lengel (1986) states that the communication efficiency between people is affected by the fitness of the media and the characteristics of the communication task. According to Daft et al. (1986), media richness is based on the criteria of the medium’s capacity to:

1. provide immediate feedback,
2. transmit multiple cues (body language, facial expressions and tone of voice),
3. convey language variety of verbal and non-verbal information (e.g. signs and symbols); and
4. personalise the message to convey the emotions and feelings of the message sender

If a communication medium is rich, there will be less uncertainty and ambiguity associated with the task and hence there will be less effort required to use it which may result in the user experiencing more satisfaction in using it (Lee et al., 2007). Lim and Benbasat (2000) have also found that a medium that allows for sending and receiving of multiple cues to be perceived as useful. Thus, from the perceived media richness (PMR) of online lecturing mediums, it is hypothesised that:

H4: PMR has a positive impact on PU of using online video media

H5: PMR has a positive impact on PEOU of using online video media
RESEARCH METHODOLOGY

A questionnaire was developed based on items adapted from prior studies that had demonstrated validity and reliability. To fit the context of this study, minor wording adjustments were made to the questionnaire items. Participants were asked to state the extent to which they agree with that statement using a Likert scale with 5 options with 1 being strongly disagree and 5 strongly agree.

A total of 135 responses were collected from a major Australian university; 48 from the abstract group (business and law disciplines) and 87 from the practical group (science, engineering and built environment). Among the respondents, 64% were male and 36% female. The respondents had varying teaching expertise from associate lecturers to professors, and reported different levels of self perceived computer usage. The average respondent was aged in the 46-55 age group with an average of 13 years lecturing experience and good (self perceived) computer literacy. Regarding usage of the technologies under study, all participants had either ‘never’ used or ‘rarely’ used these technologies.

Data analysis of the research model was conducted using Partial Least Squares (Smart-PLS 2.0 M3), a structural equation modeling technique. PLS is being used as it is a primary technique for causal-predictive analysis in situations of low theoretical information and is appropriate for the early stages of theory development (Howell and Higgins 1990). Since the use of Online media for lecturing purposes is still in the early stages (at least widely in academia and given the recent availability of tools such as YouTube and video technology) with no known literature exploring the acceptance and effect on its use to higher learning institutions, PLS is appropriate for this study.

RESULTS

To ensure that meaningful results were drawn from the structural model, the measurement model was first assessed for discriminant and convergent validity.

Measurement Model

Evaluation of the measurement model (outer model) involves examining the relationships between the indicators and its corresponding construct for discriminant and convergent validity. In PLS, Divergent validity was assessed by examining intercorrelations, AVE and cross loadings. Convergent validity was assessed by checking loadings and weights, Cronbach alpha and composite reliability.

The composite reliabilities of all reflective construct scales ranged from 0.855 to 0.945 which exceeds the minimum threshold value of 0.60 (Hair et al. 2006; Hulland 1999). Similarly, Cronbach alpha values of all reflective construct scales ranged from 0.778 to 0.912 which exceeds the recommended threshold value of 0.70 (Chin 1998) and 0.6 for exploratory studies. Bootstrapping method (200 resamples) was used to test the validity of the constructs and the significant level of
regression path coefficients. All items loaded substantially high on their intended construct with relatively small cross loadings. All loadings were found to be significant at p<.001 level.

All AVE values were higher than 0.5 (which implies that at least 50% of the variance of the indicators are accounted for (Chin 1998). Furthermore, the square root of AVE for each construct was larger than the correlation between the assigned construct and any other construct in the correlation matrix, thus demonstrating good discriminant validity (Chin 1998).

As both convergent and divergent validity of all reflective constructs were met, the constructs were considered reliable and valid.

**Structural Model**

The structural model (inner model) is a representation of the relationships between the constructs. To assess how well the structural model predicts the hypothesized paths, the path coefficient value for each exogenous/endogenous pair and R square values for endogenous LVs was considered. A large number of paths were found to be significant as shown in figures 2 and 3 which outlines the overall results from PLS with bootstrapping (200 resamples). The results indicate considerable support of the model with an R-Square value of 0.632 and 0.489 for behavioural intention. Additionally, blindfolding with an omission distance of 25 was run. For the structural model to possess predictive relevance, $Q^2$ value has to be greater than 0 (Chin 1998). All $Q^2$ values were above 0.37, thus the structural model has satisfactory predictive relevance.

***p<0.01, **p<0.05, *p<0.1 (based on one-tailed test)

**Figure 2. Structural Model – Abstract courses**

***p<0.01, **p<0.05, *p<0.1 (based on one-tailed test)

**Figure 3. Structural Model – Practical courses**
DISCUSSION

Consistent with previous studies, PU was found to have significant relationships with predicting intention to use online video lecturing. Perceived Usefulness was found to be the dominant determinant in predicting intention to use online lecturing. This indicates that the perceived usefulness of these technologies is particularly important for academics. It was found that the perceived media richness of the technologies had a significant relationship with perceived usefulness. This implies that if academics perceive the media to be rich, the more likely they will find it useful.

However, there were striking differences between the 2 groups for the relationships involving PEOU. For the practical group, PEOU was found to have significant relationships with PU and BI, however no such relationship was found with the abstract group. A possible explanation for this result is that the abstract group reported a higher self perceived computer efficacy score of 4.625 (1 being poor and 5 being excellent, with the respondents being asked to rate themselves in terms of computer literacy) whilst the practical group had a lower score of 4.23. The abstract group may already be comfortable with technology and thus not see how the ease of use can lead to improved usefulness of the technology or lead to their use of the technology. However for a group that is less familiarised with technology, the inability to use the technology would ultimately render it as useless and the group not having any intentions to use it even if it is perceived to be as useful. Hence for the practical group, university management may consider providing workshops, manuals and IT support to help improve the computer self efficacy of academics. It is also possible this group they didn’t see the delivery medium as being appropriate and this may have had some effect on their assessment of computer efficacy – in this case the focus of support might have to move to medium itself.

LIMITATIONS AND CONTRIBUTIONS

The first limitation is the generalisability of the current study as all data will be collected from one university; hence, the results will be difficult to generalise to other higher education institutions as each university has different preparedness in accepting e-learning initiatives. Other limitations include the possibility that some relevant constructs are not included and response bias.

Nevertheless, this study contributes to literature through its identification of contributing factors surrounding lecturer’s acceptance of online lecturing. Importantly, the results help to dispel the belief that online lecturing is only suitable for courses that are heavily theoretical and abstract in nature as both groups found that online lecturing as possessing high perceived media richness and was perceived as useful. Furthermore, findings from this study can be used by educational organisations to help gauge whether the use of online lecturing would be a success within their own learning environment and introduce initiatives to help reduce the negative factors/perceptions.

REFERENCES


**APPENDIX – SURVEY QUESTIONS**

<table>
<thead>
<tr>
<th>Perceived-usefulness</th>
<th>Adapted from</th>
</tr>
</thead>
<tbody>
<tr>
<td>I believe the use of the following online media system is helpful for my teaching</td>
<td>Liaw et al.(2007)</td>
</tr>
<tr>
<td>The quality of students’ learning in my course will be improved by using the following online media system</td>
<td>Mahdizadeh et al.(2008)</td>
</tr>
<tr>
<td>In general, I believe the following online media system will boost students’ learning interests</td>
<td>Tao(2008)</td>
</tr>
<tr>
<td>Perceived-ease-of-use</td>
<td></td>
</tr>
<tr>
<td>Learning to operate the following online media system should be easy for me</td>
<td>Davis(1989)</td>
</tr>
<tr>
<td>It is easy for me to become skilful in using the following online media system</td>
<td></td>
</tr>
<tr>
<td>I think online video media will be difficult to operate</td>
<td></td>
</tr>
<tr>
<td>Behavioural Intention</td>
<td></td>
</tr>
<tr>
<td>I intend to use the following online media system when it becomes available</td>
<td>Ajzen&amp;Fishbein(1980)</td>
</tr>
</tbody>
</table>
I intend to use the following online media system in my teaching as often as possible when it suits the teaching task

**Perceived Media Richness**

<table>
<thead>
<tr>
<th>If the lecturers feel very strongly about something (positively or negatively), the following online media system allows them to show their feelings.</th>
<th>Guo et al. (2008)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The following online media allows the lecturer to add meaning to what they want to say by using as many cues (body language, voice, tone, etc) as possible.</td>
<td></td>
</tr>
<tr>
<td>The following online media system allows the lecturer to be flexible with the way language (verbal, non-verbal and/or graphics) is used in order to increase understanding</td>
<td></td>
</tr>
</tbody>
</table>

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1 As online lecturing is essentially a one-way communication channel for academics to deliver lecture content to students, feedback immediacy criterion in the media richness theory wasn’t applied in this study.
Gender and Tenure Issues Relating to Faculty Perceptions of Web-based Learning Materials

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Ling He
University of North Carolina Wilmington
HEL@UNCW.EDU

ABSTRACT

This paper addresses whether or not gender and/or tenure status can affect a faculty member’s perception of web-based learning materials. Specifically, perceptions about the effectiveness of web-based materials and whether creating these materials affects a faculty member’s chances for promotion and tenure. The survey was conducted in 2002 and again in 2008 to measure perceptions and also to see if perceptions have changed over time.

One dimension of creating web-based learning materials is the search for and integration of web resources into the course content. There has been a considerable increase in the array of Internet resources since the 2002 survey and many of them can affect instruction/learning. YouTube was created in 2005 and has already become a virtual guest lecture source with videos including everything from Thomas Friedman presenting lectures on “The World is Flat” to Gordon Moore speaking on his view of the next 40 years of “Moore’s Law.” Many universities have created Second Life sites for learning communities and individual courses. It could be argued that the increase in the availability of such web-based resources would lead to a view of increased impact on instruction/learning and that faculty utilizing such resources and incorporating them into their course materials would be rewarded with greater chances of promotion and tenure.

Our analysis shows that, as a whole, there was no statistically significant change in faculty perceptions between 2002 and 2008 on either the effectiveness of Web-based learning materials or the impact that the creation and use of those materials on the tenure process. However, when we categorize faculty by tenure status and gender the perceptions of tenured, male faculty on the effectiveness of Web-based materials did fall significantly.

Keywords

Online learning, web-based learning, tenure, gender.

INTRODUCTION

The development of online learning materials is important for several reasons. One reason is the sheer number of students taking online courses. In the Fall of 2007 almost 4 million U.S. college students were taking an online course – that represents over 20% of U.S. higher education students (Allen and Seaman, 2008). A second reason is the tenure/promotion reward system for faculty who develop the online course materials consumed by the ever increasing number of students. Ever since Boyer (1990) questioned the role of non-research efforts in scholarship, there has been more interest in capturing non-research scholarship (such as developing web-based materials) in the tenure and promotion process.

The respondents’ perceptions of online course efficacy compared to traditionally taught materials are important. If faculty members believe learning efficacy is increased or decreased by the use of online course materials versus traditionally taught courses it should influence their decision regarding the creation of online materials. Second, the perception of respondents concerning the value of creating online course materials as an effort that leads to promotion and tenure is important. Activities that do not lead to promotion and tenure are marginalized by faculty.

A 2002 survey (Schell, 2004) revealed that although much interest and many resources have been expended on the development of web-based learning materials, the value of those efforts are marginalized in the promotion and tenure decision. In fact, faculty that put effort into developing web-based materials at the expense of traditional efforts in research and teaching reduce their chances of promotion and tenure. In the years since the 2002 survey there has been a great expansion of web-based resources available to faculty members.

Before these new resources can be made into web-based learning materials they need to be found, researched, mastered, and then imbedded into course content. YouTube was created in 2005 (purchased by Google in 2006) as a user-driven site for sharing short videos and has inadvertently become a source of digital guest lecturers ranging from Thomas Friedman...
Schell and He

Gender and Tenure Issues – Web-based Learning Materials

lecturing on “The World is Flat” to Gordon Moore’s lecture on his vision of Moore’s Law for the next 40 years. Universities have joined the social networking phenomenon with Second Life, MySpace, Facebook, LinkedIn, Twitter, among others. BlackBoard and WebCT merged in 2005 and created a single organization that had over 3,000 university and college clients – and more universities are using it each year. The content and the infrastructure for content delivery has greatly evolved and expanded since the 2002 survey. You Tube and streamed videos are individual creations but finding the pertinent materials and embedding them into a structure for web-based consumption is itself a creative process. Much like a box of nails, a hammer, and a collection of wood are separate creations, but when a carpenter creates a desk from these materials the desk is itself a new creation.

This paper will analyze 2008 survey responses to see if changes occurred between the 2002 and 2008 data. Specifically, is there a change in (1) perceptions of the effectiveness of web-based learning materials and/or (2) perceptions of the impact that the development of web-based learning materials have on the promotion and tenure decision. Since the six year interval represents a span of time when tenure decisions are likely to be made, tenure status is analyzed. Also, since respondents to the survey have a higher proportion of females than in the general faculty population the effects of gender on these perceptions are analyzed.

SURVEY

The 35 questions in the survey cover faculty demographics, school demographics, perceptions about web-based materials use and perceived effectiveness, and finally the respondent’s perceptions of the academic value of creating web-based learning materials by those persons and committees that will make decisions during the promotion and tenure process.

An e-mail seeking survey participants was sent to faculty who had publicly associated with web-based learning materials through a discussion forum, journal or conference presentation or publication, membership in a user group focused on web-based learning materials, or some similar connection. This is important because this research seeks to measure perceptions of those faculty actively pursuing web-based materials and their perceptions on its effect of attaining promotion and/or tenure as opposed to the general faculty population. In each instance, the person had furnished his/her e-mail address.

Web-based learning materials have been defined in various ways (Schank, 2001; Tsai and Machado, 2002). The majority of the definitions say web-based learning occurs via a web browser. Web-based learning materials are those that are created specifically for browser interaction or a collection of materials facilitated by the use of web browsers. For example, combining original materials found on the web with a blog, threaded discussion, or some other interactive web technology.

SURVEY RESULTS

The data in this analysis was restricted to U.S.A. faculty with no administrative duties who were either tenured or on tenure track. Administrators and part-time faculty were excluded because we wanted opinions about the impact that developing web-based materials had on the tenure decision to be expressed from a full-time faculty member’s perspective. The two volumes of Online Learning as a Strategic Asset (McCarthy and Samons, 2009, Seaman, 2009) are very good sources but the views are from administrators and select faculty that often have held an administrative role in online/web-based university efforts. Since the tenure decision process can be very different outside the U.S.A., and may not even be relevant, only U.S.A. responses were considered.

There were 325 usable responses from 2002 and 490 responses in 2008. Across the years 47% of respondents were female and 72% had tenure. Of the 2008 respondents, 69% had taught a web-based course and 96% had used web-based learning materials in courses they taught. The high percentage of respondents who use and/or develop web-based materials leads to a bias in the survey. However, we feel this group of respondents is best able to respond to the survey questions.

Below are two tables showing mean responses to the effectiveness of web-based materials and the effect of developing web-based materials on the decision for promotion and tenure. The tables show mean responses by survey year, gender, and tenure status. The 2002 and 2008 surveys have a statistically significant difference between males and females (.011) and between tenured versus tenure track respondents (.016) concerning their views on the effectiveness of web-based materials. For the question of the impact of creating web-based materials on the promotion and tenure decision, there were no statistically significant changes from 2002 to 2008.

Table 3 is very important because it shows the combination of gender and tenure responses. Note that the values are very similar except for a single cell – the combination of tenured males in 2008. It is the single issue driving the statistical significance. There is no immediate explanation to this result based on the survey responses.
<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>3.26</td>
<td>2.93</td>
</tr>
<tr>
<td>Female</td>
<td>3.05</td>
<td>3.06</td>
</tr>
<tr>
<td>Tenured</td>
<td>3.25</td>
<td>2.97</td>
</tr>
<tr>
<td>Not Tenured</td>
<td>3.02</td>
<td>3.10</td>
</tr>
</tbody>
</table>

Table 1. Mean Values of Responses to Effectiveness of Web-based Materials (Scale 1 to 5, less to more effective)

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>5.46</td>
<td>5.36</td>
</tr>
<tr>
<td>Female</td>
<td>5.40</td>
<td>5.67</td>
</tr>
<tr>
<td>Tenured</td>
<td>5.42</td>
<td>5.39</td>
</tr>
<tr>
<td>Not Tenured</td>
<td>5.39</td>
<td>5.97</td>
</tr>
</tbody>
</table>

Table 2. Mean Values of Responses to Impact on Tenure Decision (Scale 0 to 10, no impact to critical)

We did not expect that responses from tenured males would be so dominating in the survey results. Literature about correlating gender and technology issues tends to find differences between males and females concerning perception of usefulness, ease of use, and other characteristics of information systems and technology. However, it was the combination of both tenure status and gender that dominated the results. We expected that either gender or tenure status would influence the perception of efficacy. We require further analysis to explain this phenomenon, probably by a second survey.

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male, Tenured</td>
<td>3.37</td>
<td>2.90</td>
</tr>
<tr>
<td>Male, Not Tenured</td>
<td>3.02</td>
<td>3.05</td>
</tr>
<tr>
<td>Female, Tenured</td>
<td>3.05</td>
<td>3.03</td>
</tr>
<tr>
<td>Female, Not Tenured</td>
<td>3.06</td>
<td>3.14</td>
</tr>
</tbody>
</table>

Table 3. Mean Effectiveness of Web-based Materials Responses by Combined Gender/Tenure Responses

A secondary result of the analysis shows that the dispersion of responses changed from 2002 to 2008. Probably as important a finding as the tenured male anomaly is that the responses in 2008 were much more concentrated about the mean value. A Kolmogorov-Smirnov two-sample test reveals the sample distributions from the two surveys have a significantly different distribution across their frequency distributions. The 2008 responses show a stronger central tendency for both the effectiveness of web-based materials and also the impact that developing web-based materials may have on the promotion and tenure decision. Figures 1 through 4 depict the frequency distributions of web-based learning materials compared to traditional materials. Tenure status between the different years and gender are presented in the figures.
Figure 1: Effectiveness of Web-based Materials Compared to Traditional Materials – 2002

Figure 2: Effectiveness of Web-based Materials Compared to Traditional Materials – 2008
CONCLUSION

The analysis of the data is continuing. The similarity in mean scores between the two surveys is both comforting and disturbing at the same time. Comforting in that there is stability in faculty perception. Disturbing because the rapid increase in available resources to support web-based learning materials seems to imply an intrinsic increase in their use. It can be speculated that when Tim Berners-Lee developed a system that would later be known as the World Wide Web (proposed in 1989 and first implemented in 1990) and the 2002 survey there had not been enough time for a consensus to develop concerning web-based learning materials. Education 2010 (Briggs, et al, 1989) made some very good predictions about the education technology that was to follow 20 years later yet many of the leaders of this conference spent little time on
web-based learning after the conference. Did their departure from online learning portend the future views of male, tenured faculty?

The 2008 data is much more concentrated near the mean observation values. This represents a convergence of opinion, a consensus of the effectiveness of web-based learning materials and also the impact of a faculty member’s creation of web-based learning materials related to tenure and promotion.

The mean values were close to the center value of the response choices. For web-based materials effectiveness, the value 3 was the midpoint between the 1 and 5 extreme points. And 3 was almost the exact mean value. Clearly the respondents did not feel there is a substantial difference. To the respondents, web-based and traditional learning materials are equally effective.

The response to the question concerning the impact that developing web-based learning materials has on the promotion and tenure decision is similarly balanced. That scale went from 0 (no importance) to 10 (critical). The value 5 is the midpoint and mean responses among the subgroups in 2008 were from the mid 5.36 to 5.97. While that difference is a statistically significant increase from 5.00 it does not carry a lot of practical weight. Faculty relying upon their development of web-based materials will find it has no influence. Especially compared to the impact of research and traditional teaching measures.

The surprising result of the analysis is that the variance from 2002 to 2008 could be determined by the single subgroup of tenured males. Their substantially lowered views of web-based materials efficacy is not yet explainable. They had the highest mean rating in 2002 yet the lowest mean rating in 2008. We hope to further analyse this finding and report our conclusions at the conference.

REFERENCES
USING SCENARIOS TO UNDERSTAND INDIVIDUAL TECHNOLOGY CAPABILITY CHOICES

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mitchellaj@appstate.edu

ABSTRACT

This paper reports the findings from a survey regarding technology choice. The survey sought to explore how individuals decide which technology they are going to use when there are hundreds of technologies available in today’s marketplace. Subjects were presented with scenarios where they had to perform a task in which they might need multiple technology capabilities. Subjects then had to decide what collaboration technologies they would consider. Some interesting conclusions are made for individual technology choice which has implications for group technology choice and negotiation.

Keywords

Individual technology choice, group technology choice, collaboration technology, technology capabilities, scenarios.

INTRODUCTION

Virtual teams collaborate independently across space and time through the use of collaboration technologies (Dubé & Paré, 2004; Lipnack & Stamps, 1997). Understanding technology choice is especially important for virtual team work as their entire work process takes place through the use of collaboration technologies. How do virtual teams decide which technology they are going to use to work together? Do they use technologies they have experience with? Do you they use the technologies that provide the easiest access? Or do they actually choose technologies which have the best task-technology fit for the task at hand? Furthermore, who is selecting the collaboration technology? Is it the virtual team leader or manager or is there a negotiation process that takes place where team members work together to make a decision.

This research begins prior to the group negotiation process and looks at the individual level. Specifically this research asks, how do individuals decide which technology they are going to use? This research takes a first step in understanding how a virtual team, or group, decides what technology to use by looking at the operationalization of technology choice at the individual level. This operationalization of technology choice is useful for explaining choices about technological capabilities. The overall goal of this research is to survey and measure individual technology awareness.

In this paper, we present the results from a survey of technology awareness. Individual subjects are presented with scenarios where they have to perform a task (where they might need multiple technology capacities) and then they have to decide what collaboration technologies they would consider and what their final choice is. Subjects not only need to make technology decisions, but they also have to specify what technology capabilities they would use or need.

The following section presents a background on technology choice both from the individual and group perspective. The research design is presented in the subsequent section and is followed by the results of this research. The final section presents a research summary and provides some ideas for future research.

EXAMINATION OF RELATED TECHNOLOGY CHOICE THEORIES

Previous research on technology choice can be divided into two groups: individual technology choice and group technology choice. Prior research has studied individual technology choice (e.g., an individual might choose a technology they are familiar with or have heard about through word of mouth) (Goodhue & Thompson, 1995; Zigurs & Buckland, 1998) as well as group technology choice (e.g., groups might choose technologies they all have easy access to or they have used before) (Becker, Carte, & Chidambaram, 2006; Webster & Trevino, 1995). Based on this distinction, the following sections present what we know and do not know about technology choice from both an individual and group perspective.

Individual Technology Choice

Much of the research on technology choice has been impacted by research on task-technology fit, which is based on the idea of finding the appropriate tools or technologies for a specific task. Zigurs and Khazanchi (2008) compiled a selection of theories of task-technology fit, including media richness, channel expansion, task technology fit, adaptive structuration, and the fit appropriation model. These theories, and their relationships with one another, provide the background on individual technology choice.
Media richness theory (MRT) proposes a model to help managers choose the most appropriate form of communication in order to convey a message or other information (Daft & Lengel, 1986). Work related to media richness theory integrates the constructs of equivocality (i.e., ambiguity) and uncertainty (i.e., the absence of information) with respect to information processing (Daft & Lengel, 1986). Media richness theory posits that media have four fixed characteristics: 1) feedback, 2) number of cues and channels, 3) personal focus, and 4) language variety (Daft & Lengel, 1986). An example of the media richness hierarchy in use incorporates four media classifications, including 1) face-to-face (highest media richness), 2) telephone, 3) addressed documents, and 4) unaddressed documents (lowest media richness) based on the four fixed characteristics (Daft, Lengel, & Trevino, 1987). As this example shows, the richest form of communication, in terms of deploying the four characteristics of feedback, channels, personal focus, and language variety, is face-to-face communication (Daft & Lengel, 1986). Face-to-face communication allows for immediate feedback, multiple cues (e.g., facial expressions, hand gestures), a personal focus, and the use of a natural language. In other instances, it is the intelligence differences between people and their uses of technology that have to do with an individual’s ability to recognize and deploy those four characteristics for various tasks (Daft & Lengel, 1986).

Building on media richness theory, channel expansion theory (CET) incorporates experiential factors to better explain and predict user perceptions of communication media (Carlson & Zmud, 1999). Channel expansion theory enhances media richness theory by suggesting that media does not have fixed characteristics, but instead can be perceived differently based on experiential factors (Carlson & Zmud, 1999). Carlson and Zmud (1999) conclude that evolving, knowledge-based experiential factors can positively influence media richness perceptions.

Task-technology fit (TTF) posits that information technology is more likely to have a positive impact on individual performance and be used if the capabilities of the information technology match the tasks that the user must perform (Goodhue & Thompson, 1995; Zigurs & Buckland, 1998). In relation to this theory, Goodhue and Thompson (1995) present an argument that user perceptions of task-technology fit are impacted by task and technology characteristics. Additionally, their theory suggests that task-technology fit impacts performance, which is mediated by utilization.

Similarly, Zigurs and Buckland (1998) suggest that group performance is impacted by the fit profile between the task and a GSS technology. In their theory of task-technology fit, Zigurs and Buckland (1998) characterize tasks as simple, problem, decision, judgment, or fuzzy tasks, while technologies are characterized according to the degree of support for communication, process structuring, and information processing. Each type of task is then associated with a best fit technology. For example, simple tasks are associated with a single outcome and are best fit with a technology that offers high communication support, low process structuring, and low information processing so that team members can easily communicate their ideas.

Adaptive structuration theory (AST) is an approach for studying the role of advanced information technology in organizations (DeSanctis & Poole, 1994). Adaptive structuration theory begins with social structures, which are rules and resources or capabilities that provide technology and institutions as starting points (DeSanctis & Poole, 1994). The beginning social structures are then the basis for planning and accomplishing tasks, however the design of collaboration technologies impacts these social structures (DeSanctis & Poole, 1994).

Finally, the fit appropriation model (FAM) combines task-technology fit theory with adaptive structuration theory in order to benefit from both fixed and emergent processes (Dennis, Wixom, & Vandenberg, 2001). The fit appropriation model suggests that task-technology fit affects performance as it is moderated by appropriation (Dennis, et al., 2001). The fit appropriation model is about providing additional support for technology users and their ability to fit task needs with the technology.

**Group Technology Choice**

The second approach to technology choice is the study of technology choice in groups (Becker, et al., 2006; Webster & Trevino, 1995). Becker et al. (2006) suggest that individual models of technology adoption are inadequate when looking at group technology choice. They present a deterministic model which suggests the idea of the “realm of consideration.” A team member’s realm of consideration is defined as “a cognitive list of all functionalities of a given technology which the user perceives as being applicable to the task at hand” (Becker, et al., 2006, p. 1529). The deterministic model adds this construct to a model based on task-technology fit from both Goodhue and Thompson (1995) and Zigurs and Buckland (1998).

In a six-month field study of three teams, Becker et al. (2006) concluded that there is indeed a strong link between a team’s realm of consideration and their performance. For example, the team with the least homogeneous realm of consideration had the lowest performance ratings. This finding suggests that technology training in groups may be an effective management tool to facilitate desired group technology choices (Becker, et al., 2006).
This research begins with the exploration and understanding of individual technology choice in order to advance to the next step of understanding how a group decides what technology they are going to use. By studying an individual’s awareness of technology capabilities we will have a better understanding of the group’s awareness and how that is formed or negotiated. Also in this research, when looking at technology choice the focus is on technology capabilities and not overall technologies. The capabilities approach provides a more flexible way to incorporate future and unanticipated developments in tools. It should also be noted that a technology capability is different than a technology feature. For example, while a technology feature might be text chat, the technology capability would be the ability to hold text conversations. This distinction is important as many of the collaboration technologies in the market today have overlapping capabilities and features, therefore complicating the user’s choice.

RESEARCH DESIGN

Scenarios

Scenarios are stories that describe events that managers and non-specialists can understand (Gray & Hovav, 1999; Gray & Hovav, 2007). Scenarios must be 1) possible, 2) plausible, and 3) internally consistent (Gray & Hovav, 1999). Scenarios have been used in previous research to survey students about realistic situations (e.g., Petter & Vaishnavi, 2004).

Four scenarios were developed for this study. The tasks for each of the scenarios were based on the task types used in task-technology fit theory, including simple, problem, decision, fuzzy (Zigurs & Buckland, 1998). Additionally, the scenarios were developed based on tasks from previous research. For example, the simple scenario described a situation where students would have to work together in a virtual team to brainstorm requirements for a business information system (Edwards & Sridhar, 2005). The problem scenario described a situation where a contract would have to be developed between two organizations in different geographic locations (Panteli & Duncan, 2004). The decision scenario presented a scenario where individuals had to work together from different organizational roles (marketing, production and operations, and human resources) in order to make various decisions (Chang, 2004). Finally, the fuzzy scenario described a situation where students were working on a global offshore development project (Davis, Germonprez, Petter, Drum, & Kolstad, 2009).

After reading the scenario which described a group situation, subjects were individually asked to explain in detail which technology capabilities they would need to complete the group task described. Subjects were then asked which specific collaboration technologies they would consider using because they offered the necessary capabilities. Finally, subjects had to report the technology they would ultimately choose to resolve the scenario and why.

A pilot test was administered with two virtual team managers currently working in industry (experts) and two students with no virtual team experience (novices). Based on the results of the pilot test, it was determined that the scenarios were realistic, and minor modifications were made to the instrument to ensure clarity.

Survey participants

Undergraduate business students, enrolled in an introductory course at a US university, were invited to participate in this research study. The instrument was distributed to the subject list via email. Overall, 99 subjects voluntary participated.

RESULTS AND DISCUSSION

This section focuses on the development of technology choice. The primary research question asked how individuals decide which technology they are going to use. The following subsections explore this question by evaluating which technology capabilities participants felt were needed for each task, which technologies they considered, and their final choices.

Technology Capabilities

This research begins by looking at technology choice focused on technology capabilities and not overall technologies, as the capabilities approach provides a more flexible way to incorporate future and unanticipated developments in tools.

In order to achieve task-technology fit, simple tasks need technologies that allow for high communication support, low process structuring, and low information processing (Zigurs, Buckland, Connolly, & Wilson, 1999). For problem and decision tasks technology should allow for low communication support, low process structuring, and high information processing. Finally, for fuzzy tasks, high communication support, medium process structuring, and high information processing is necessary from the team technology.

Our findings, with respect to technology capabilities, indicate that individuals do not know what capabilities they need to complete different types of tasks. The simple task scenario that was presented only asked that participants brainstorm with team members to come up with a list of requirements. For this task, the technology should allow for high communication support (capabilities which support the ability to communicate with one another). The capabilities needed for this task are
either the ability to hold text conversations or the ability to see everyone. Interestingly the ability to store files, visually model ideas, and combine ideas rated higher than the actual necessary capabilities (see Table 1). On the other hand, the fuzzy task, which requires the most process structuring (capabilities which support, enhance, or define the group process, e.g., agenda setting or enforcement) actually did rate the ability to track timeline process higher than in the other three scenarios.

<table>
<thead>
<tr>
<th>Technology Capabilities</th>
<th>Simple</th>
<th>Problem</th>
<th>Decision</th>
<th>Fuzzy</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ability to store and organize files and data.</td>
<td>86</td>
<td>80</td>
<td>77</td>
<td>76</td>
</tr>
<tr>
<td>The ability to visually model concepts or ideas.</td>
<td>81</td>
<td>51</td>
<td>64</td>
<td>70</td>
</tr>
<tr>
<td>The ability to combine ideas.</td>
<td>81</td>
<td>63</td>
<td>78</td>
<td>70</td>
</tr>
<tr>
<td>The ability to hold text conversations.</td>
<td>71</td>
<td>65</td>
<td>55</td>
<td>68</td>
</tr>
<tr>
<td>The ability to store conversations.</td>
<td>70</td>
<td>70</td>
<td>71</td>
<td>73</td>
</tr>
<tr>
<td>The ability to hear everyone in the group.</td>
<td>67</td>
<td>66</td>
<td>79</td>
<td>65</td>
</tr>
<tr>
<td>The ability to track timeline progress.</td>
<td>48</td>
<td>57</td>
<td>49</td>
<td>68</td>
</tr>
<tr>
<td>The ability to see everyone in the group.</td>
<td>24</td>
<td>37</td>
<td>61</td>
<td>43</td>
</tr>
<tr>
<td>Other (including: work with other cultures, view work &amp; progress simultaneously, type &amp; listen simultaneously, no interruptions)</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: The numbers in the table represent the number of respondents that chose a particular result.

Table 1. Results from Questions of Technology Capabilities Needed

Technology Considerations

The collaboration technologies available in the market today have overlapping capabilities and features, therefore complicating the user’s choice. Once participants were able to determine what technology capabilities they needed to work on a task, it was important to see if they considered technologies which actually offered those capabilities. Interestingly, Microsoft Office Live was considered the most across all task types (see Table 2). Microsoft Office Live allows for teams to establish workspaces where files (such as Word, PowerPoint, and Excel) can be uploaded and shared across teams. This workspace tracks team modifications and allows for comments, however there is low communication support suggesting that this technology would not work for simple or fuzzy tasks. Perhaps, the survey participants planned for Skype to be a complement to Microsoft Office Live, therefore providing the necessary communication support.

<table>
<thead>
<tr>
<th>Technologies</th>
<th>Simple</th>
<th>Problem</th>
<th>Decision</th>
<th>Fuzzy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft Office Live</td>
<td>78</td>
<td>62</td>
<td>59</td>
<td>67</td>
</tr>
<tr>
<td>Skype</td>
<td>62</td>
<td>49</td>
<td>54</td>
<td>43</td>
</tr>
<tr>
<td>Google Office</td>
<td>61</td>
<td>50</td>
<td>47</td>
<td>46</td>
</tr>
<tr>
<td>Google Groups</td>
<td>34</td>
<td>21</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>FaceBook</td>
<td>32</td>
<td>13</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>iChat</td>
<td>31</td>
<td>18</td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td>FreeConferenceCall</td>
<td>29</td>
<td>22</td>
<td>32</td>
<td>31</td>
</tr>
<tr>
<td>AIM</td>
<td>29</td>
<td>20</td>
<td>19</td>
<td>16</td>
</tr>
<tr>
<td>MS-LiveMeeting</td>
<td>24</td>
<td>20</td>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td>Microsoft Sharepoint</td>
<td>23</td>
<td>16</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Zoho Office</td>
<td>21</td>
<td>11</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>Yahoo Groups</td>
<td>18</td>
<td>8</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>GoToMeeting</td>
<td>14</td>
<td>13</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>Microsoft Groove</td>
<td>14</td>
<td>12</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Central Desktop</td>
<td>13</td>
<td>6</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>LiveJournal</td>
<td>9</td>
<td>3</td>
<td>6</td>
<td>13</td>
</tr>
</tbody>
</table>

Table 2. Results from Questions of Technology Considerations

Other technologies had less than ten individuals consider them, including Lotus SameTime, Blogger, YouTube, ContentCirclees, WebEx, Huddle, MySpace, Collanos Workspace, WordPress, SecondLife, Flickr, LinkedIn, ooVoo, and iTunes. In order to address the primary research question of how these technologies are chosen, it is important to understand the reasons for the technologies considerations. Table 3 presents our findings which suggest that technology reputation is the most important reason behind technology choice. Following reputation is easy access to the technology and previous use.
Reasons to Consider the Technologies

<table>
<thead>
<tr>
<th>Reasons to Consider the Technologies</th>
<th>Simple</th>
<th>Problem</th>
<th>Decision</th>
<th>Fuzzy</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have heard from others that this technology works well.</td>
<td>74</td>
<td>65</td>
<td>67</td>
<td>62</td>
</tr>
<tr>
<td>The technology offers easy access to everyone (e.g., online.)</td>
<td>72</td>
<td>51</td>
<td>53</td>
<td>49</td>
</tr>
<tr>
<td>I have used the technology before.</td>
<td>70</td>
<td>52</td>
<td>50</td>
<td>47</td>
</tr>
<tr>
<td>The technology cost is free or minimal.</td>
<td>70</td>
<td>44</td>
<td>42</td>
<td>47</td>
</tr>
<tr>
<td>The technology is user friendly.</td>
<td>59</td>
<td>43</td>
<td>45</td>
<td>40</td>
</tr>
<tr>
<td>The technology is reliable.</td>
<td>49</td>
<td>38</td>
<td>48</td>
<td>50</td>
</tr>
<tr>
<td>The technology offers a lot of space &amp; stores info for later.</td>
<td>48</td>
<td>41</td>
<td>37</td>
<td>45</td>
</tr>
<tr>
<td>The technology is secure.</td>
<td>42</td>
<td>34</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>I have seen advertisements about this technology.</td>
<td>28</td>
<td>24</td>
<td>25</td>
<td>23</td>
</tr>
</tbody>
</table>

Table 3. Results from Question of Technology Consideration Reasons

Advertisements had the least impact on technology considerations; however cost, user friendliness, reliability, space, and security were all important considerations.

Final Technology Decisions

The final choices were not much different than the technologies that were considered (see Table 4). Microsoft Office Live again topped the results, followed by Skype and Google Office. There was a little more variation with the problem, decision, and fuzzy tasks. However, the popularity of Microsoft Office Live to address the simple task is a surprise considering the scenario asked for brainstorming and a file sharing technology was found to be the most popular.

Table 4. Results from Questions of Technology Choice

<table>
<thead>
<tr>
<th>Technology</th>
<th>Simple</th>
<th>Problem</th>
<th>Decision</th>
<th>Fuzzy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft Office Live</td>
<td>43</td>
<td>25</td>
<td>21</td>
<td>34</td>
</tr>
<tr>
<td>Skype</td>
<td>14</td>
<td>19</td>
<td>18</td>
<td>7</td>
</tr>
<tr>
<td>Google Office</td>
<td>12</td>
<td>16</td>
<td>9</td>
<td>19</td>
</tr>
<tr>
<td>MS-LiveMeeting</td>
<td>5</td>
<td>5</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Microsoft Groove</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Google Groups</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>FreeConferenceCall</td>
<td>1</td>
<td>7</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>GoToMeeting</td>
<td>1</td>
<td>1</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Zoho Office</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>1</td>
</tr>
</tbody>
</table>

Other technologies had three or fewer individuals select them across the various task types, including Facebook, Yahoo Groups, iChat, Microsoft Sharepoint, WebEx, SecondLife, Content Circles, Blogger, LinkedIn, Collanos Workspace, WordPress, YouTube, LiveJournal, Huddle, Central Desktop, Lotus SameTime, AIM, and ooVoo.

Table 5 summarizes the reasons behind the final technology choice. Reputation, again, is found as the most important.

Table 5. Results from Question of Technology Choice Reasons

<table>
<thead>
<tr>
<th>Reasons to Finally Choose a Technology</th>
<th>Simple</th>
<th>Problem</th>
<th>Decision</th>
<th>Fuzzy</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have heard from others that this technology works well.</td>
<td>27</td>
<td>30</td>
<td>28</td>
<td>29</td>
</tr>
<tr>
<td>I have used the technology before.</td>
<td>16</td>
<td>19</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>The technology offers easy access to everyone (e.g., online).</td>
<td>12</td>
<td>10</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>The technology is reliable.</td>
<td>12</td>
<td>10</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>The technology is user friendly.</td>
<td>6</td>
<td>10</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>The technology offers a lot of space &amp; stores info for later.</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>I have seen advertisements about this technology.</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>The technology cost is free or minimal.</td>
<td>3</td>
<td>7</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>The technology is secure.</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Other (including: minimal costs and training will not be necessary due to popularity. SecondLife is my life)</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

CONCLUSIONS, LIMITATIONS, AND FUTURE RESEARCH

This paper has presented an exploratory empirical study of how individuals make technology choices. The results provide initial evidence to suggest that individuals do not know what capabilities or technologies they need to complete different types of tasks. With this exploratory understanding of the individual decision process, it is clear that decision making by the team leader, or a team negotiation process where team members work together to make a decision, is critical.

Overall, the data shows that individuals tend to rely on technology reputation as the primary reason for considering or choosing technologies. Easy technology access and previous use follow as two other important reasons to consider or choose technologies. These conclusions are subject to the limitation of our research design, specifically with regard to the sample size and the nature of the tasks included.
size and the fact that student subjects were used who may not have the technology awareness of practitioners. However, because this research relied on scenarios, the results of the study are similar to what is experienced in practice.

Future research needs to be conducted to identify what forms of training can be used to increase collaboration technology familiarity. Research can be done to determine who should administer this training (teachers, team leaders, or technology driven interventions) as well as whether this training should be face-to-face or virtual.

REFERENCES
ABSTRACT

Confirmation bias is a driver of problematic decision making. People search information supporting current beliefs and ignore real critical evidence. Counter-argument i.e. providing evidences opposite to preferred beliefs was shown to have an effect on reducing confirmation bias. This study advances past studies by separating counter-arguments into two types and examining their effects in different stock investment contexts. We attempt to show that different types of counter-arguments are needed under different decisional contexts.

Keywords

Confirmation bias, counter-argument, de-bias, risk aversion

INTRODUCTION

Human beings are boundedly rational. Problematic subjective judgments during cognitive processes prohibit people from making the right decision by distracting them from rationally accessing and utilizing information, which then lead to overtrading and low profitability in financial markets. Researchers refer to these problematic subjective judgments as cognitive biases. Behavioral decision making literatures indicate that intrinsic cognitive biases exist in the decision making process and these cognitive biases have a negative impact on decision making (Arnott, 2006). Therefore, contemporary computer supported decision making tools were developed to reduce biases mentioned by Tversky and Kahneman (1974).

However, the rationalization of a decision-making process by formalizing it within a computer-based information system does not seem to make the process itself more rational (George et al., 2000). The bias that operates without the information system continues to operate within it (e.g. Jiang et al., 1995, Barber and Odean, 2002). To fill this gap, some researchers have entered significant efforts in understanding how DSS can provide de-bias function to eliminate confirmation bias during decision making process (e.g. Huang, 2009). The results revealed that confirmation bias can be effectively reduced through providing counter-arguments.

Although previous research has built a foundation by showing that counter-arguments can effectively reduce negative consequences of confirmation bias, over simplified research setting limits the value of findings and implications. There is a need to explore the concept in a more complex setting in order to understand phenomenon thoroughly. For example, counter-argument is solely defined as information conflicting to current beliefs but, however, it can be separated in advance into two types – argument opposite to the preferred one or supporting alternatives. It is reasonable to suspect that these two types of counter-argument may not always generate the same effect. Furthermore, past research only employed one type of task (to arrange money into two stocks) in the experiment. However, in the stock market, traders may buy or sell stock in their daily life - that is, different types of task. Putting these two concepts together, we believe that people tend to weigh different types of counter-argument differently when they face different decision tasks (e.g. buy or sell). Specifically, based on risk aversion perspective (Elton and Gruber, 1997; Kahneman and Tversky, 1979), we predict that, to avoid risk, information which shows that the target stock won’t perform well will generate more countering effect when traders attempt to buy it. In contrast, when traders attempt to sell one of several stocks in hand, more countering effects can be generated by providing evidences which show that other stocks in hand may be perform worse.
In a summary, although the effect of counter-argument in specific task has been shown by past research, whether DSS should provide different types of counter-argument under different tasks is not clear. Therefore, under computer-supported decision making context, this study focuses on understanding how different types of counter-argument may generate different level of effect under different types of decision tasks - buy or sell stock. Experiments will be conducted to examine these proposed ideas.

**LITERATURE REVIEW AND HYPOTHESES**

In this section, we first review the literature about confirmation bias and its impact on decision making. In the following section, we then define counter-argument and classify it into two types. Research models and hypotheses are then developed based on the review.

**Confirmation bias and its impact on decision outcome**

Most people have a bias while carrying out a concept or verifying an assumption. Within this bias, people tend to restrict their attention to a favored hypothesis, prefer treatment of evidence supporting existing beliefs, look only or primarily for positive cases, overweight positive confirmatory instances, and see what one is looking for (Nickerson, 1998). That is, “decision-makers seek confirmatory evidence and do not search for disconfirming information.” (Russo et al., 1996; Heath, 1996; Arnott, 2006). Wason (1960) defined it as confirmation bias and indicated that individuals tend to seek evidence in support of their assumptions, instead of searching for and comparing evidence against their assumptions.

Confirmation bias may defeat decision making in several ways (Nickerson, 1998). First, people tend to restrict themselves to the preferred hypotheses only and ignore, intentionally or unintentionally, other possible hypotheses. Second, people tend to look for information fitting to their existing beliefs. Third, with information at hand, people tend to overweight the information that fits with their beliefs and disconfirm the information that does not fit their hypothesis. Even in ambiguous situations, where both positive and negative supports are provided, people only need a little positive evidence to support their hypothesis (Pyszczynski and Greenberg, 1987). For example, medical doctors may overweight some test results and underweigh, or even ignore other possible explanations while diagnosing (Casscells et al. 1978). The consequence of overweighing some evidence and underweighing other evidence is reaching a wrong conclusion.

With formed beliefs, decision makers tend to focus on specific hypothesis only or, if multiple hypotheses are considered, choose the information which fit their beliefs. They may also distort the information and explain it in ways which fit their beliefs. The effects of confirmation bias reflect on two broadly discussed decisional characteristics: decisional adjustment and confidence. Decision makers suffer from error anchoring and inadequate adjustment (Tversky and Kahneman, 1974). Adjustment refers to the tendency for decision maker to be influence by additional information. Additional evidence may be positive or negative and people adjust their beliefs in either direction (increase or decrease) according to the additional information (Ashton and Ashton, 1988). Tversky and Kahneman (1974) indicated that, in general, it is difficult for people to anchor in the correct value initially and insufficient or inappropriate adjustment is made while concerning other positive or negative information related to the initial decision. Subjects may adjust their decision toward the center (no difference between two options) or move away from center (strong preference toward one target). People move their decision to center when they are less confident toward their prior preference. This happens when decision makers receive information opposite to the prior preference. In contrast, decision makers move their final decision to one end when they receive information fitting with their preference, which increases the degree of confidence. With confirmation bias, moving away from center is expected because decision makers actively read information which fits with their prior preference.

H1a: People with confirmation bias tend to adjust their decision away from the center to their previous preference.

Decision confidence refers to the subjects’ beliefs regarding their investing performance and their perceived probability that their decisions are correct (Peterson and Pitz, 1988; Davis and Kottemann, 1994). It is not rare for people to be over optimistic and under estimate the risk and over estimate their problem solving ability (Kahneman and Riepe, 1998). This happens in many professional fields, such as financial investing, and tends to be greater for difficult tasks. Griffin (1996) indicates that optimism serves as a driving force for over estimating that the favored outcome will occur. Confidence tends to be higher when people seek support for their initial view rather than to look for disconfirming evidence (Russo and Schoemaker, 1992). Therefore, we hypothesize that

H1b: People with confirmation bias tend to be more confident toward their decision.
De-bias: Computer-mediated counter-argument

Various de-bias functions were proposed to counter confirmation bias and those propositions were examined by empirical studies (Keren, 1990; Fishoff, 1982; Bazerman, 2002; Russo and Schoemaker, 1992). Theory indicates that once one’s belief is formed, it is not easy to change if there is no other stimulus (Hoch and Deighton, 1989). Counter arguments encourage decision makers to consider why their initial assumptions might be wrong or ask others to give them counter arguments. For example, Block and Harper (1991) found that warnings can usefully reduce the effect caused by anchoring and insufficient adjustment, although it cannot be eliminated completely. Moreover, George et al. (2000) conducted a similar experiment to test whether the existence of warning can reduce or eliminate anchoring and adjustment biases. The result shows that the cognitive biases that exist under without a computer-supported environment continue to exist within it. Conceptual and empirical studies indicate that there is a need to provide stimulus to challenge one’s belief so that the decision making process can be more rational (Russo and Schoemaker, 1992; Gorman, 2005). Empirical studies also showed that computer-mediated counter-argument can effectively reduce irrational confidence and allow decision makers to adjust their decision to the right direction. In previous study, the moderating effect of counter-argument has been proposed and confirmed (Huang, 2009).

Counter-argument refers to evidence opposite to current beliefs and it can be separated into two types: alternative-support and self-opposite. Alternative-support type of counter-argument refers to arguments providing positive evidence which show that other non-preferred options are as good as or superior than the preferred one. On the other hand, self-opposite type of counter-argument refers to arguments providing negative evidence which show that the preferred options may not perform as good as expected or even worse than other non-preferred options. Although the effect of counter argument has been illustrated, past research has mixed these two types of counter-argument and, therefore, cannot answer whether different types of counter-argument can generate different effects. To answer this question in this study, we adopt risk aversion concept and attempt to show that the reduction of the effect of confirmation bias by counter argument is determined by whether counter-argument fits the task in hand.

The fit between the types of counter-argument and task

Kahneman and Tversky (1979) found that traditional expect utility theory can not fully explain the human decision-making behavior under uncertainty and risky situations. To explain it, they proposed the Prospect theory. According to reflection effect (one effect of prospect theory), decision makers are risk-averse in the positive domain and are risk-seeking in the negative domain. Kachelmeier and Shehata (1992) demonstrated that people tend to make different decisions depending on the choice task which involves buying or selling stock. Decision makers tend to perform risk-seeking behaviors while buying and tend to perform risk-aversion behaviors while selling stock (Kachelmeier and Shehata, 1992; Holt and Laury, 2002). Since traders buy and sell stock in their daily life and possess different attitudes toward risk, this elicits our interest in investigating the effect of counter-argument under these two tasks. Furthermore, we explore which type of counter-argument can fit into the task and generate better effect in de-biasing. In the following, we discuss the effect of counter-argument type in different types of task.

The buying task

When people attempt to add one a stock among several stocks into the portfolio, according to confirmation bias theory, they tend to read information which shows this stock is profitable or shows that other stocks are non-profitable. That is, people search and read information which fit into their existing mental model. They ignore those messages opposite to existing mental model because those messages are considered as inappropriate or wrong. Therefore, counter-argument is required to remind decision maker that other options may be also profitable (other-support) or the preferred one may not be so profitable (self-opposite) (Kahneman and Tversky, 1979; Kachelmeier and Shehata, 1992; Holt and Laury, 2002). However, according to risk aversion perspective, people try to avoid potential risk which may lead to the loss of money. Therefore, traders tend to pay more attention to evidence which shows that the preferred stock may not as profitable as expected because it represents a high possibility of losing money. On the other hand, people tend to pay less attention to evidence which shows that other non-preferred stock may be as profitable because the preferred target is still profitable.

The consequence of confirmation bias is abnormal decisional confidence and inadequate adjustment of decision. These consequences imply that decision makers overweight messages which fit into their pre-preference and ignore important messages during the decision making process. Therefore, we hypothesize that

\[
H2a: \quad \text{Under buying context, compared with subjects who receive alternative-support counter-argument, confirmation bias has less effect on decision adjustment for subjects who receive self-opposite computer-mediated counter-argument.}
\]
H2b: Under buying context, compared with subjects who receive alternative-support counter-argument, confirmation bias has less effect on decision confidence for subjects who receive self-opposite computer-mediated counter-argument.

The selling task

When people attempt to sell a portion or total of one stock in hand, according to confirmation bias theory, they attempt to check evidences which show that the target stock is not worse to be possessed or other stocks in the portfolio are more worth to be kept in the future (Elton and Gruber, 1997; Kachelmeier and Shehata, 1992). Therefore, counter-arguments refer to evidences which show that the selected stock (to sell) may perform much better than expected (self-opposite) or other stocks may perform much worse than expected (alternative-support). Under this context, risk aversion refers to avoiding losing money from selling the wrong stock. Therefore, to traders, alternative-support type of counter-argument tend to draw more attention from traders since those evidences imply that keeping those stocks equals to losing money. That is, risk increases if they choose to keep those stocks. In contrast, self-opposite type counter-arguments generate less impact because they only show that the selected target may not perform as bad as expected which is far less important than losing money through keeping those stocks may decrease the total value. Therefore, we hypothesize that

H2c: Under selling context, compared with subjects who receive self-opposite type of counter-argument, confirmation bias has less effect on decision adjustment for subjects who receive alternative-support type computer-mediated counter-argument.

H2d: Under selling context, compared with subjects who receive alternative-support counter-argument, confirmation bias has less effect on decision confidence for subjects who receive self-opposite computer-mediated counter-argument.

RESEARCH METHODS

In this project we focus on the moderating effect of counter argument, an experiment will be conducted to test listed hypotheses. The model is showed in Figure 1. A stock investment task is selected because DSS are intensively adopted to support stock investment decision making to cope with high uncertainty and process data in large quantities. A GUI-based DSS, with 4GL programming language and a relational database management system, will be developed for the experiment. Actual designing activities will follow Hung et al., (2007)’s recommendations. A total of 256 subjects are expected to be recruited. Since our predefined task is stock investment, we will focus on subjects with stock or other investing experience.

![Figure 1. Research model](image)

EXPECTED RESULTS

A couple implications for academia can be gleaned from this project. First, past study has shown the existing of confirmation bias in stock investment task. This study aims at providing another piece of evidence to show how confirmation bias take places in different decision making context. Second, we attempt to show that different type of counter-argument is needed for different type of tasks. For practitioners, this project serves as an example which shows the decision support systems designer that how different types of de-bias means can be incorporated into the system design to effectively counter cognitive biases.
ACKNOWLEDGEMENT
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REFERENCES


THE TWITTER-GENERATION ENCOUNTERS THE CLASSROOM

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ABSTRACT
A number of faculty have barely grasped the technologies developed in the late 20th century. Moving into the 21st century has been problematic for many. Concepts such as Wikis, Blogs, Alerts, Widgets, and Text messaging are ways of using the Internet in which they are neither familiar nor comfortable. Moreover, with an ever increasing, culturally diverse, international student population, classroom interaction has decreased as many of these students are reticent to ask questions. Each year the gulf between a technologically savvy student population and faculty has increased. We propose a text messaging system based on short messaging service (SMS). The ease of use of this system makes it readily attractive to faculty, while the interactive, real-time questioning capabilities improve students’ classroom experiences utilizing their mobile devices.

Keywords
SMS, Web 2.0, pedagogy, text messaging

TEXT MESSAGING IN THE CLASSROOM
In a traditional classroom environment, the instructor is solely responsible for interaction with the students. The instructor chooses to ask questions and decides which students are allowed to comment on the lecture. Faculty who prefer high levels of interaction encourage students to ask questions. However, students differ on their learning approaches (Karabenick 2003). Cultural differences may result in many students reticent to ask questions (Shen, Wang et al. 2008). General personality traits often limit certain students in their capacity to interact with either the instructor or their peers (Barkhuus and Dourish 2004). With larger classes, interaction is much more problematic (Barkhuus 2005).

Can the omnipresence of students’ mobile devices be leveraged to use SMS in a subject-directed manner? Rather than attempting to stop students from using the technology, can instructors co-opt their current usage pattern into a more positive, curriculum-oriented approach? Most attempts reported earlier have been done on a small-scale with a minimum of scientific rigor. With the exception of Shen, et al. (2008), the scale of past studies has been limited to a few classes with a particular academic department.

THE PARTICIPANTS
The initial inspiration for this study came to this author as an epiphany while attending a professional hockey game. Between periods, the scoreboard showed “live” text messages to the arena audience. This concept is at the heart of Web 2.0. I.e., leveraging technology to increase social presence to a wide audience and improve communication within that audience. This is a technology in which most readers are familiar. If this technology can be used without any instruction or training to focus hundreds of thousands of audience members to scoreboards in a myriad of sporting venues, then why should this same concept not find success in the classroom?

The author contacted the company providing this technology to the sporting venue. This company provided this same SMS service to most professional sporting teams in the United States. A partnership was established between this leading provider of SMS applications and a large southeastern university in which the author held an appointment. The benefits to the SMS provider was a new market to exploit with their existing suite of applications modified for the educational market. The benefit to the university was free services customized to enhance communication between instructor and student.

THE SMS SYSTEM
One of the main goals in modifying this system for classroom use was to maintain the ease-of-use found in the original application...for both the student and the instructor. The new system, dubbed TQS™ (Text Questioning System), allows a student to text a question to an SMS number. The question must be prefixed with the course’s unique computer number. This computer-number is then parsed in the database to distribute the correct series of questions from the correct section. Besides maintaining a database of student questions, the host SMS server also sends out an RSS feed based on the section number. In turn, each course section, hosted by the Microsoft SharePoint portal, includes an RSS feed reader Web used for
displaying the questions from the class. As the student’s question is broadcast in a scrolling banner at the bottom of the classroom display screen, it is also simultaneously being stored and displayed on the Web which allows for students and faculty to review at a later time. Moreover, each section includes an SMS group study wiki for students to discuss the class questions. The wiki is monitored by the instructor by utilizing an “alert.”

CURRENT STATUS
As of the spring semester in 2010, most of the testing for the SMS system has been completed. A very simple, step-by-step, training manual has been published for faculty (the manual only requires a few pages of instructions…including graphics). Technical issues, reporting issues, security issues, FERPA-compliance issues, legal liability issues, and university infrastructure approval have been resolved. The implementation plan has begun with a pilot program using faculty. The pilot testing phase continues through the spring 2010 semester. The purpose of this pilot is for ascertaining proof-of-concept, discovering flaws and weaknesses in the system, and enhancing the overall operation by suggestions elicited from faculty and students. By the fall 2010 semester, the system will be available to all 30,000 university students.

REFERENCES
IDENTIFICATION OF INFLUENTIAL FACTORS THAT AFFECT STUDENTS’ BEHAVIORS IN TRADITIONAL CLASSES VERSUS TECHNOLOGY-MEDIATED LEARNING (TML) CLASSES

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ABSTRACT

Learning environments are rapidly changing from the traditional setting to include the use of multimedia technology in the classroom. In the past, researchers studied how the use of technology as a learning tool affects students’ learning and performance. There are, however, few studies that report students’ learning behavior in technology based learning environments. The purpose of this study is to find out whether or not there are any unique behaviors exhibited by students that are related to a different learning environment. In this study, two researchers observed two undergraduate elementary statistics classes (traditional class versus Technology-Mediated Learning (TML) class), and documented student behavioral differences between them. The data included quantitative and qualitative observations based on specific behavior categories. The results of the analysis lead to identification of six influential factors that affect students’ learning behaviors in different learning environments. Implications of results for both educators and administrators are discussed.

Keywords

Technology-mediated learning, observation, student behavior

INTRODUCTION

While Technology-Mediated Learning (TML) has been studied by psychology or educational researchers, Information Systems (IS) researchers have also been investigating TML in terms of educational and learning effectiveness. Due to the job market’s evolving business environment, the influx of students to business school has also increased the number of students learning using TML as opposed to learning in a traditional classroom (Gemeinhardt, 2002). In a TML study, researchers have sought to answer “How does technology enhance learning?” (Alavi and Leinder, 2001, p. 5) Typically, TML is defined as “a learning experience that is significantly moderated through the use of information and communication technology” (Alavi and Gallupe, 2003, p. 140). Under this definition, most TML studies by IS researchers compared the learning outcomes of the traditional classroom and TML classroom by employing IT instructional methodology (Alavi and Leinder, 2001). TML researchers have investigated whether the use of technology made any significant difference in student learning outcomes when compared with traditional teaching methods (Alavi, 1994; Leidner and Fuller, 1997; Leidner and Jarvenpaa, 1993). Unfortunately, the results have not been consistent. Some researchers proposed that the learning environment did not have any effect on students’ learning abilities; additionally, some researchers stated that the TML methodology fails to elicit more effective learning results than individually different technology, student’s characteristics, and instruction methodology (Hsiao et al., 2006). For example, Mintu-Wimsatt (2001) compared student course evaluations between students in a traditional, face-to-face classroom and those in a TML classroom. The results indicated that students in the TML classroom gave lower class ratings than did the students in the traditional classroom. One recent study also concluded that there were no differences in terms of learning effectiveness and student satisfaction between computer-mediated instruction (CMI) and lecture-mediated instruction (LMI) (Jamero, Borghol, and Mihr, 2009). However, other researchers believe that the use of technology can improve students’ learning abilities (Bull et al., 1998). Several previous TML studies have focused on the input-output designs rather than employing the theoretical background (Gupta and Bostrom, 2009); therefore, those studies suffered from a lack of appropriate, comprehensive theoretical guidelines for further study. Recently, Gupta and Bostrom (2009) suggested a theoretical model by adopting the Adaptive Structuration Theory (AST), which “has a global perspective that encompasses the important elements of the learning phenomenon and can use theories from educational psychology” (Gupta and Bostrom, 2009, p. 707). Hsiao et al. (2008) tested Alavi and Leinder’s model by employing a case study; they concluded that learning context and psychological foundation was the key to TML’s effectiveness, as well as technological features and instructional method (Hsiao et al., 2008). Regarding the performance perspective in a TML study, most
measures of learning performance involved only the students’ self-reported learning outcomes or final grades; therefore, the significance of these learning behaviors on the final learning outcome has been questioned. The TML studies indicated that the outcomes of learning effectiveness were highly dependent on students’ individual characteristics (Alavi and Leinder, 2001); therefore, direct observation of classes is an excellent methodology to use when attempting to understand student behaviors and characteristics in various classroom environments (Mehan et al., 1982; Turanli and Yildirim, 1999).

Using this premise, this research study used the observation methodology (Rose et al., 2005) to increase understanding of students’ behavior (Mehan et al., 1982). The objectives of this study are to 1) employ observers to compare student behavior in two different Introduction to Statistics classes (traditional vs. TML classes), 2) identify student behavioral differences in the two classes, and 3) classify these observations into factors that show how students retain knowledge as well as those factors that foster interaction between the instructor and students. The following sections describe the research design, results of the class observations, and, the findings of the study. The final section concludes the paper and provides implications for educators.

RESEARCH DESIGN

Contents Covered In Classes

The research study was performed in an Introduction to Statistics for Business and Economics class. The class contents covered in both the traditional and TML classes were identical and used the same textbook. The topics covered included: 1) how to gather, summarize, or describe data; 2) how to make statistical inferences about a population based on sample information; and 3) what kinds of statistical analyses are appropriate and necessary to answer particular questions.

Observation Environments

The observation environments of the current study are presented in Table 1 below. Traditional class refers to a classroom where an instructor teaches contents. As a supplemental tool, an instructor console (i.e., an instructor computer and document projector) is provided in the classroom. In the TML class, the instructor teaches contents using MS Excel spreadsheets in a computer lab while simultaneously giving verbal explanations. Each student has access to a computer where he/she is capable of emulating what the instructor does using his/her own computer.

<table>
<thead>
<tr>
<th>Instructional Methods</th>
<th>Traditional Class</th>
<th>Technology-Mediated Learning Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Listening to a lecture and taking notes</td>
<td>Listening to a lecture and working with MS Excel</td>
<td></td>
</tr>
<tr>
<td>Classroom Environment</td>
<td>Traditional classroom (with an instructor console)</td>
<td>Computer lab (with an instructor console and student computers)</td>
</tr>
</tbody>
</table>

Table 1. Experimental research design

Observation Subject

Two sections of an introductory statistics classes for undergraduate students were taught at a large southeastern university. The traditional class had an enrollment of 47 students whereas the TML class had 23 students. Due to the limited capacity of a computer lab, fewer students were enrolled in the TML class than in the traditional class. Students were not allowed to cross over to the other class during the semester. Lectures were given to both classes every Tuesday and Thursday and lasted 75 minute each during the semester.

Observation Instrument and Process

The researchers designed an observation instrument based on past research and consultation with other educational experts (available from authors). Observational data were split into two categories: quantitative observations and qualitative observations. The quantitative observations consisted of class-related behaviors, class-unrelated behaviors, and overall attentiveness. As every class began, observers initially checked student attendance. Then, during class hours, observers counted the frequencies of both class-related and class-unrelated students’ behaviors. Observers also checked student attentiveness using a 5-point scale ranging from poor (1) to excellent (5) at three points during the class period. For qualitative observation data, observers noted any noticeable student behaviors or activity in the classroom. Observers were allowed to stand up and watch the students’ behaviors as long as this did not disrupt the class. Any participation, however, was not permitted. The two observers attended the TML classroom for a total of 24 class days (total 1800 minutes) and the traditional classroom for 12 class days (total 900 minutes). To prevent the inconsistence of recording observations during the semester, the two observers summarized their observation forms every two weeks and made necessary modifications so that the data collection was completely consistent.
RESULTS

Observations

The results of quantitative observation are shown in Table 2. First, for the quantitative results of class-related behaviors, the TML class had a higher attendance rate than the traditional class (80% and 75%, respectively). In terms of the average number of students who “attempt to verbally answer question posed by the instructor,” the rate of answering questions was 20% in the traditional class, a 2% drop when compared to the TML class. However, the rate of asking questions was 15% higher in the traditional class than the TML class (26% and 11%, respectively). The average number of students who were able to “help a classmate with a computer or calculation task, understand a concept, and interpret a question” had a 6% higher rate in the TML class over the traditional class (11% and 5%, respectively). Second, the results are described with respect to the class-unrelated behavior. The average number of students who were “doing work from another course” was 9% higher in the TML class than in the traditional class (11% and 2%, respectively). An average of 14% of students in attendance who were “sleeping or conducting running conversation with neighbor” were observed in the traditional class with the rate decreasing by 3% in the TML class, which was 11%. The average number of students who were “surfing web or reading email” was 15% higher in the TML class than in the traditional class (27% and 8%, respectively). “Daydreaming” was 6% more prevalent in students attending the traditional class compared with the TML class (11% and 5%, respectively).

<table>
<thead>
<tr>
<th>Categories</th>
<th>Items</th>
<th>Traditional class</th>
<th>TML class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance</td>
<td>Total in attendance</td>
<td>35 (75%)</td>
<td>18 (80%)</td>
</tr>
<tr>
<td>Class-related behaviors</td>
<td>Attempt to verbally answer a question posed by the instructor</td>
<td>7 (20%)</td>
<td>4 (22%)</td>
</tr>
<tr>
<td></td>
<td>Ask a question about the material</td>
<td>9 (26%)</td>
<td>2 (11%)</td>
</tr>
<tr>
<td></td>
<td>Help a classmate with a computer or calculation task, understand a concept, or interpret a question</td>
<td>2 (5%)</td>
<td>2 (11%)</td>
</tr>
<tr>
<td>Class-unrelated behaviors</td>
<td>Doing work from another course</td>
<td>1 (2%)</td>
<td>2 (11%)</td>
</tr>
<tr>
<td></td>
<td>Sleeping or conducting running conversation with neighbor</td>
<td>5 (14%)</td>
<td>2 (11%)</td>
</tr>
<tr>
<td></td>
<td>Surfing web or reading email</td>
<td>3 (8%)</td>
<td>5 (27%)</td>
</tr>
<tr>
<td></td>
<td>Daydreaming</td>
<td>4 (11%)</td>
<td>1 (5%)</td>
</tr>
<tr>
<td>Attentiveness</td>
<td>Overall attentiveness on 5-point scale at 10th minute</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Overall attentiveness on 5-point scale at 40th minute</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Overall attentiveness on 5-point scale at 70th minute</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 2. Quantitative description of observations

No significant attentiveness differences were found at the 10th, 40th and 70th minutes after the start of class between the two classes. In addition, qualitative observations were written by the observers at the end of each class and summarized.

FINDINGS

Quantitative Observation

<table>
<thead>
<tr>
<th>Categories</th>
<th>Higher-rated items between class types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class-related behaviors</td>
<td>Traditional Class</td>
</tr>
<tr>
<td>Asking Questions</td>
<td></td>
</tr>
<tr>
<td>Helping other students</td>
<td></td>
</tr>
<tr>
<td>Class-unrelated behaviors</td>
<td>Sleeping and Conversation</td>
</tr>
<tr>
<td></td>
<td>Daydreaming</td>
</tr>
</tbody>
</table>

Table 3. Higher-rated items between class types

Table 3 summarizes findings. These two categories indicate that the students in the TML class responded more readily to the instructor and interacted more freely with other students than those who were in the traditional class; however, the students in the TML class showed more passive attitudes in terms of asking the instructor questions compared with the traditional class. Likewise, two items in the class-unrelated behaviors category also had recorded rates higher in the TML class than in the traditional class: “Doing work from another course” and “Surfing web or reading email.” Two other class-unrelated behaviors, “Sleeping or conducting running conversation with neighbor” and “Daydreaming,” showed higher rates in the traditional class than in the TML class.
Qualitative Observation

Based on the observations, the results were analyzed and led to the identification of six influential factors under the categories of student learning and interaction between the instructor and students. We describe each of these categories (Table 4).

Student Learning

Student learning is divided into three factors: understanding content, attentiveness, and lose track of lecture. First, we define these factors. Understanding the content is defined as the students’ understanding of new concepts by their responses during the lecture (i.e. nodding, confirming by question, and explaining to others). Second, attentiveness is defined as how much students concentrated on other activities during the instructor’s lecture. Last, lose track of the lecture was defined by the accessibility and availability of reference and the frequency of referring to the material when they seem to have trouble understanding. Students in the TML class used spreadsheets as a reference material; however, students in the traditional class used their notebook as a major reference material.

<table>
<thead>
<tr>
<th>Categories</th>
<th>Influential Factors</th>
<th>Student Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TML Class</td>
</tr>
<tr>
<td>Student Learning</td>
<td>Understanding content</td>
<td>Rare Responses</td>
</tr>
<tr>
<td></td>
<td>Attentiveness</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Lose track of the lecture</td>
<td>Harder to recall</td>
</tr>
<tr>
<td>Interaction between instructor and student</td>
<td>Distance between instructor and student</td>
<td>The shorter the distance, the better the responses received from students</td>
</tr>
<tr>
<td></td>
<td>Eye contact</td>
<td>Less eye contact</td>
</tr>
<tr>
<td></td>
<td>Seating pattern</td>
<td>No effect</td>
</tr>
</tbody>
</table>

Table 4. Influential factors toward student behaviors

Understanding the content

During the semester, it was observed that students in the traditional class showed better responses, implying they better understood the lecture content. Comparatively, in the TML class, rather than understand the concepts, students tended to concentrate more on how to emulate the spreadsheet what the instructor did.

Attentiveness

When the instructor verbally explained concepts, students were more attentive in the traditional class than in the TML class. Students in the TML class possibly assumed that working on the spreadsheet was considered a classroom activity, resulting in less attentiveness than when they were not working on the spreadsheet.

Lose track of lecture

Students in the traditional class seemed to easily catch up on new materials delivered regardless of whether or not previous lectures were missed. Students in the TML class, however, gave the impression of having difficulty understanding the lecture once they lost track of the lecture. The observations appeared to show that students in the traditional class always brought their textbook and continuously took notes as their references. On the other hand, the students in the TML class rarely took notes while working on the spreadsheet. Accordingly, they seemed to have a limited access to written references on their encountered-difficulties. There were also differences in terms of understanding the problem-solving process. The students in the traditional class appeared to easily understand the problem-solving process by referring to their notebooks, but the students in the TML class appeared to have difficulties following the steps of a problem-solving procedure. Rarely, students looked up the written references but most students did not. Whether students had the references on their hand or not affected the frequency in which the instructor’s questions were answered. The students in the traditional class often looked up the references while they strived to answer the questions, but students in the TML class usually did not attempt to answer at all.

Interaction between Instructor and Student

This category had three factors: maintaining eye contact, distance between instructor and students, and seating pattern. We describe the results for each of these factors.

Maintaining eye contact

While most of students in the traditional class concentrated their attention on the instructor during lecture hours, students in the TML class looked at either the projected screen where the instructor’s key strokes appeared, or at their computer monitors.
Those differences dictated how frequent the chances of eye contact with the instructor were. Likewise, the instructor spent a large portion of the lecture time on operating the spreadsheet to lead the lecture; consequently, the instructor rarely had the chance to make eye contact with the students in either class.

**Distance between the instructor and students**

The class attentiveness increased when the instructor approached the students in both the traditional and TML class settings. If the instructor walked close to the students, then the students turned their attention more on the lecture or operated the spreadsheet program in a more serious manner. In addition, the student who was located closest to the instructor appeared to have better response rates than students who sat some distance away. Students also returned to the lecture very quickly when they were distracted from other work if the instructor approached them.

**The seating pattern and response rates**

The seating patterns were self-selected because students could freely take a seat at any place in both the traditional and TML classes. The seating patterns were different in every class. However, most of seating patterns were a U- or D-shape in the traditional class. Interestingly, the response rate of questions depended on the seating patterns in the traditional class. Most of answers came from the students who sat in the first three rows and rarely from the very back of the classroom. Additionally, if the instructor stood in the left corner, the left-side-seated students answered most of the questions. Likewise, right-side-seated students behaved in the same way if the instructor headed to the right corner of the classroom.

**IMPLICATIONS**

**Implications for Educators**

The results of this study have several implications for educators in designing classes and delivering them. First, the students’ behavior and attitude toward lectures were affected by the instructors’ behavior: 1) limited eye contact allows the easy distraction of students’ attentiveness, and 2) a shorter distance between the instructor and students caused students to concentrate more on the lecture in both the traditional and TML class settings. Second, the observations showed that the traditional classroom appeared to be a more effective learning environment since students offered more responses to questions, did not fall behind in lectures, and easily looked up references. Third, providing Internet access to the students during the classes seemed to be a less effective learning environment because students surfed the web for personal work rather than working on lecture-related topics.

**Implications for Administrators**

While reviewing the observations, the current study discovered that the seating design of a classroom and placement of computer equipment had an impact on students’ learning behaviors. First, the computer equipment setting can be positioned to get more students’ attention on the lecture. There are more chances to make eye contact with the instructor if the computer display is placed under the desk in the TML classroom. Second, the design of seats needs to be effective so that effective communication between the instructor and the students can happen.

**LIMITATIONS AND FUTURE RESEARCH**

This research has several limitations. First, two observers viewing the same situation might evaluate the same behavior differently. To minimize these discrepancies, observers reviewed each other’s observations on a regular basis and adjusted the standpoint for future observations. However, despite this effort, we cannot disregard subjectivity of observations. Second, one observer only attended the computer-environment classroom and the other observer attended both the traditional class and the TML class. Attending both the classes might serve to create a different perspective for the observer when that observer sees some phenomenon take place in both classes.

This study uses a less rigorous research framework and brings a sense of thoroughness (not rigor) to the research. This study needs to be extended to include student-performance pegged observations. Future study needs to exhibit rigor in methodology and model proposition. Statistical analysis needs to go deeper than the surface treatment of the data collected. Effectual outcomes are needed for creating and substantiating interventions that could follow a research of this nature.

**CONCLUSIONS**

This paper is the result of observational research conducted in two classroom settings: a traditional classroom and a TML classroom. The purposes of this study were to compare student behaviors in two different Introduction to Statistics classes via observation. The students in the traditional classroom performed more class-related activities than did the students in the TML classroom. While both the traditional classroom and the TML classroom allowed students to learn independently, this research indicates that the traditional classroom provides a better learning environment for the study of Introduction to Statistics. Many existing studies point out that TML results in better learning performance. However, the results of this study suggests otherwise (i.e. Ozdemir et al., 2008; Hsiao et al., 2009, etc.). In this study, one of the problems of TML classroom is that it allowed students to access the Internet during class time. Observers noticed that students seemed to be easily attracted...
to web-surfing that was unrelated to class work. This could significantly impact the students’ learning behavior in the TML class. Overall, both classroom environments provided advantages: the TML classroom encouraged cooperation among students on their learning activities, and the traditional classroom allowed students to become actively involved in the lecture.

REFERENCES

INTRODUCTION TO DATABASE SYSTEMS: PORTING THE CAMPUS-BASED COURSE TO AN ONLINE ASYNCHRONOUS FORMAT

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ABSTRACT
More and more courses are being ported to an asynchronous online format. Courses in which learning outcomes include mastery of a technology component, such as a database system, introduce additional challenges. This paper investigates student perceptions of the value of various types of instructional materials and methods for facilitating faculty contact utilized in an online introductory database course. The findings suggest that detailed online lecture notes have the most value with high ratings also given to narrated lecture notes and online interactive tutorials. Learning activities and assignments were also deemed to be extremely important with over eighty-nine percent of the students indicating preference for weekly assignments. The most common method used for faculty contact was email and students consistently cited that quick response turnaround and instructive feedback enhanced learning. In an online course, student learning can be enhanced by incorporating a variety of instructional materials and requiring students to frequently engage in structured learning activities.

Keywords
Online learning, asynchronous format, database, instructional materials

INTRODUCTION
Online courses are becoming more and more prevalent. According to the latest available data from the Sloan Consortium, more than 3.94 million students took an online course during the fall semester of 2007 representing more than twenty percent of US higher education students (Allen and Seaman, 2008). Eighty percent of these students were enrolled in an undergraduate course. Even institutions that traditionally offered only campus-based courses are porting courses to an online format. Typically online courses are offered in a synchronous, asynchronous or blended mode. In a synchronous course, students and teacher are separated by location but meet together at the same time. Technology, such as web or videoconferencing, supports the real-time interaction of the participants. The primary difference between a synchronous class and a campus-based class is distance. In an asynchronous course, students and teacher are separated by location and time. Course materials, activities, exercises and assessment instruments such as exams, are placed online whereby students engage with the materials independently. Interaction may be promoted through such activities as discussion forums but generally all coursework is done outside real-time interaction, i.e. asynchronously. A blended method incorporates both synchronous and asynchronous components. This paper investigates porting an introductory database class to an asynchronous online format.

There are many challenges to the development of an asynchronous online course. As Duke (2002) points out, there is more to the pedagogy than simply putting professors’ lecture notes on the web. Oblinger and Hawkins (2006) site the need for the application of deliberate instructional design starting with the development of specific and targeted learning objectives that can be mapped to specific learning activities and measurable outcomes. Specifically they perceive that online courses must move from delivery of content to a series of ‘learning environments and activities’ of which interaction is a critical component. Henry and Meadows (2008) espouse that these learning activities must engage and immerse the student as well as put them in charge of their own learning and Krichen (2009) states that a variety of learning activities are needed to accommodate various student learning styles. While a range of factors contribute to a successful online course, the most critical factor is the design of the student learning experiences (Clear, Haataja, Meyer, Suhonen, Varden, 2001). The need for a well-designed and well-implemented online course inclusive of a variety of well-defined learning activities is especially pertinent when course learning outcomes include development of technological computing skills where students must demonstrate the act of doing as well as the act of knowing.
COURSE OVERVIEW

Most computing and information systems programs offer an introductory database course. The course generally requires students to develop conceptual and analytical skill related to data modeling and design as well as develop skill in database implementation and query building using an actual database technology. In an ideal situation, the course may even be taught in a computer lab or computer equipped classroom. The goal of this project was to port the introductory database class to an online format retaining the learning outcomes specified for the campus-based course. The course is offered as a sophomore level course with the only prerequisite being an introductory computing class. In other words, expectations of previous student interaction with or knowledge of computing technologies was limited. While the course is required for information systems majors, the course is opened to students in all disciplines. The course is focused on three areas, database design, introduction to the Structured Query Language (SQL) and topics related to multi-user databases such as transactions and concurrency, database security and database ethics. Specific learning outcomes state that upon completion of the course students will be able to:

- Describe and discuss the role of data and information in society, how that data is most commonly retained electronically and explain what a database management system does
- Model data relevant to a database task, given a written description, reports and other information from a system user -- results should be represented as an Entity-Relationship Diagram
- Transform the entity-relationship model into a logical design, following the relational approach
- Normalize a given set of tables to third normal form
- Compose working SQL statements for simple and intermediate queries.
- Build and modify a database schema using SQL
- Insert and modify data using SQL
- Define locking techniques used to control the consequences of concurrent data access
- Name and describe common database security issues and identify ways to address potential database security vulnerabilities
- State ethical guidelines for data collection for database projects.
- Use an integrated development environment such as Microsoft Access to construct a set of simple input forms and output reports.

Assessments included three exams and a comprehensive project. Several modifications were made in the instructional support, instructional materials and learning activities implemented in the online version of the course. Two forms of lecture notes were posted each week including both instructor-narrated and non-narrated detailed PowerPoint lecture notes. Learning activities were also assigned each week. These included online interactive tutorials, quizzes, online discussions and learning exercises. Students were required to install and use two different database technologies, Oracle 10g Express (free version of Oracle) and Microsoft Access 2007 provided to students through the Microsoft Academic Alliance (MSDNAA) program.

The first topic introduced in the course was database design specifically related to relational database systems. Concepts covered included entities and attributes, relationships, cardinality, constructing Entity Relationship Diagrams (ERDs), mapping ERDs to database tables and normalization. For each topic, students completed an online interactive software tutorial and either an online quiz or an exercise implementing the concepts under study. The interactive software tutorials utilized are included as modules in the Animated Database Courseware project, developed under a National Science Foundation curriculum development grant and made freely available at http://adbc.kennesaw.edu. As part of the learning exercises, students were required to construct ERDs. No specific drawing tool was mandated. However, a PowerPoint template composed of ERD symbols was provided as well as an instructional guide for using ‘Gliffy.’ Gliffy (http://www.gliffy.com) is an online drawing tool that allows users to create up to five diagrams free-of-charge.

The Structured Query Language (SQL) was presented in a graduated fashion beginning with development of queries on a single table, using joins on multiple related tables and finally using SQL to create tables and insert, update and delete data. As with database design, interactive software tutorials and weekly exercises were assigned. The tutorials included interactive software modules from the ADbC courseware as well as the freely available SQL tutorials provided by W3Schools.
Initially, students were instructed to manually construct SQL statements and encouraged to use Oracle 10g Express to accomplish this. Query design features included in both Access and the browser-based window of Oracle 10g were later introduced accompanied by separate instructor developed instruction guides. Finally, students were exposed to the input form and output report features included with Microsoft Access as these were required components of the course project. In addition to supplemental materials provided with the text, students were given access to computer-based training modules on using Microsoft Access.

Other topics covered in the course included concurrency and transaction processing as well as database security and database ethics. Software animations from the ADbC site were used to demonstrate concurrency control utilizing various locking techniques. In the area of database security, ADbC animations were used to demonstrate access control, SQL injections, inference and database auditing. Database ethics was presented using various case-based scenarios. Students were asked to investigate and discuss the ethical issues presented in the cases through a forum provided in an online discussion board.

Overall, the objective in the design of the online introductory database course was to guide students through the course material by utilizing a variety of instructional materials and requiring students to frequently engage in structured learning activities.

**STUDENT PERCEPTIONS**

At the close of the course, students were asked to complete an anonymous survey indicating their perceptions of the value of the various types of learning materials provided in the course and the effectiveness of the venues provided for faculty contact. Twenty-nine of the thirty-two students enrolled in the course responded to the survey. Students were asked to assess the importance of online lecture notes, online narrated lecture notes, online interactive tutorials, online discussions and assignments using a scale of 1-5; 5 representing the highest value. Students were also asked to state whether they felt assignments and participation in online discussions should be required on a weekly basis. Four of the five instructional materials included on the survey received a weighted average score greater than 4. Discussion forums received a lower rating; in fact more than half of the students rated this category as having no opinion, not important or not needed. Seventy-six percent of the students did not feel that weekly discussions were beneficial. All students rated the lecture notes as important with more than 86% stating they were extremely important. The narrated lecture notes were also seen as important, although a minority of respondents gave them a lower rating. In the free response section of the survey, two students indicated that the content provided in the non-narrated lecture notes met their learning needs so they did not need the additional support provided in the narrated notes. Other students indicated that the narration significantly added to their learning experience. While the majority of respondents rated the tutorials as extremely important, just over 20% were neutral in terms of their importance and another 3 students indicated they were not important. Again, articulated responses about the tutorials were mixed. Two students indicated that the tutorials were not particularly helpful while three students indicated they were extremely useful and one student even indicated a desire for more tutorials to be included in the course. All but one student rated the assignments as important or extremely important and when asked if assignments should be required weekly, 89% agreed. One student indicated that weekly assignments were needed to reinforce the concepts and another student indicated they helped to keep the student from falling behind. Table 1 shows student responses giving the frequency, percentage and weighted average.

<table>
<thead>
<tr>
<th>Instructional Material:</th>
<th>Extremely Important N</th>
<th>%</th>
<th>Important N</th>
<th>%</th>
<th>No Opinion N</th>
<th>%</th>
<th>Not Important N</th>
<th>%</th>
<th>Not Needed N</th>
<th>%</th>
<th>Weighted Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture Notes</td>
<td>25</td>
<td>86.21%</td>
<td>4</td>
<td>13.79%</td>
<td></td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
<td></td>
<td>4.86</td>
</tr>
<tr>
<td>Narrated Lecture Notes</td>
<td>18</td>
<td>62.07%</td>
<td>5</td>
<td>17.24%</td>
<td></td>
<td>5</td>
<td>17.24%</td>
<td>1</td>
<td>3.45%</td>
<td></td>
<td>4.38</td>
</tr>
<tr>
<td>Tutorials</td>
<td>16</td>
<td>55.17%</td>
<td>4</td>
<td>13.79%</td>
<td></td>
<td>6</td>
<td>20.69%</td>
<td>3</td>
<td>10.34%</td>
<td></td>
<td>4.14</td>
</tr>
<tr>
<td>Assignments</td>
<td>17</td>
<td>58.62%</td>
<td>11</td>
<td>37.93%</td>
<td></td>
<td>1</td>
<td>3.45%</td>
<td>0</td>
<td>0.00%</td>
<td></td>
<td>4.55</td>
</tr>
<tr>
<td>Discussion Forums</td>
<td>4</td>
<td>13.79%</td>
<td>8</td>
<td>27.59%</td>
<td></td>
<td>11</td>
<td>37.93%</td>
<td>4</td>
<td>13.79%</td>
<td>2</td>
<td>6.90%</td>
</tr>
</tbody>
</table>

Table 1. Student Perceptions of the Value of Various Instructional Materials

*Proceedings of the Southern Association for Information Systems Conference, Atlanta, GA, USA March 26th-27th, 2010*
In an asynchronous online class, without the advantage of scheduled face-to-face class time, interaction between faculty and students is facilitated through electronic mediums. Studies indicate that faculty member accessibility, quick response times and quality interaction between faculty and student directly contribute to effective online learning experiences (Krichen, 2009). In this course, faculty accessibility was provided via email, telephone and weekly online ‘virtual office hours’ facilitated via an online chatroom. In addition, weekly physical office hours and a general class discussion board were made available.

Table 2 represents student responses to their perceptions of the value of the online venues. Email received the highest rating, and in fact, was the most commonly used method for one-on-one faculty-student interaction. Approximately half of the students reported no opinion in terms of phone support with 26% indicating it was not important and one indicating it was not needed. During the semester, phone contact between faculty and student occurred six times. Virtual office hours were scheduled at the same time every week. During this time, students could login and participate in a real-time interactive session with the faculty member. The low weighted average received for the chatroom sessions is in keeping with the fact that this option was sparsely used by students. Most weeks, no students participated and during the course of the semester only three students ever logged into the chatroom during virtual office hours. It is interesting to note that no student indicated virtual office hours were not needed. Physical office hours were maintained but as with the virtual office hours, students did not take advantage of this method of contact. Students did participate in the general class discussion thread. Students were encouraged to post course related questions in this forum and also to respond to classmate inquiries. Most issues raised in this forum were related to course logistics such as questions about due dates or formats for assignment submission.

### Table 2. Student Perceptions of the Value of Various Methods of Faculty Contact

<table>
<thead>
<tr>
<th>Faculty Contact Modes:</th>
<th>Extremely Important</th>
<th>Important</th>
<th>Neutral</th>
<th>Not Important</th>
<th>Not Needed</th>
<th>Weighted Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Email</td>
<td>N=22, 75.86%</td>
<td>N=7, 24.14%</td>
<td>N=0, 0.00%</td>
<td>N=0, 0.00%</td>
<td>N=0, 0.00%</td>
<td>4.76</td>
</tr>
<tr>
<td>Phone</td>
<td>N=3, 10.34%</td>
<td>N=5, 17.24%</td>
<td>N=14, 48.28%</td>
<td>N=6, 20.69%</td>
<td>N=1, 3.45%</td>
<td>3.10</td>
</tr>
<tr>
<td>Chatroom</td>
<td>N=1, 3.45%</td>
<td>N=2, 6.90%</td>
<td>N=18, 62.07%</td>
<td>N=8, 27.59%</td>
<td>N=0, 0.00%</td>
<td>2.86</td>
</tr>
</tbody>
</table>

CONCLUSION

Developing an asynchronous online course, especially one in which students are required to master a computing technology such as a database system is challenging. As Oblinger and Hawkins (2006) point out, it is more about creating a learning environment than putting a course online. The online learning environment has its own unique characteristics. Faculty – student interaction is separated by both time and location. This precludes the opportunity for immediate feedback as is afforded in the face-to-face physical classroom. Consequently it is not enough to simply provide students with content; online instruction must be designed such that students become actively engaged in pursuing the learning objectives. Further the role of the faculty member and the student change. The faculty member is no longer just a provider of content but a designer of student learning experiences (Seiber, 2005). The student must develop processes and methods to become an independent learner who builds skills in time-management, asking questions and staying motivated (Roper, 2007).

A core component of any online course will be found in the content provided. As indicated in this study, students identified the course lecture notes as the most important instructional material. However, the presentation, format and organization of the content are paramount to student success. There is less opportunity for students to ask for clarification so more detail must be provided and supplemental means to reinforce concepts are necessary. Online learning experiences must also require students to frequently engage in task-based activities and course-based assignments. Finally, quick turnaround to student questions and instructive feedback on course assignments contribute to enhanced learning as well as student satisfaction with the learning experience (Hopper and Harmon, 2000).
The demand for asynchronous courses will continue to increase. If for no other reason, they provide an opportunity to extend the reach of higher education in a format that can provide an effective learning experience. However, success depends on the purposeful and strategic design of course learning outcomes, course structure, course content, supplemental instructional materials and course learning activities. This requires deliberate and concerted effort on the part of the faculty member as an online course requires frequent faculty interaction, dialogue, mentoring and coaching (Oblinger and Hawkins, 2006).

REFERENCES:


ABSTRACT

Poor data quality has been shown to have a serious impact on organization performance including increased operational cost and ineffective decision-making. In response to poor data, many organizations take on data cleansing projects as part of ERP and data warehouse implementations. These projects can be extremely difficult and produce less than desired results.

This study will examine the data cleanup efforts taken on by an organization specializing in implementing and maintaining benefits modules for an ERP system. In particular this study will build on research in traditional software development and examine the impact of the conversion and cleansing team’s experience with the source systems, the target system and systems within a similar domain on the accuracy of data following the conversion and cleanup effort.

Keywords

Data Quality, Information Quality, Data Administration, Data Warehousing, ERP

INTRODUCTION / MOTIVATION

Poor data quality within enterprise systems can have a profound impact on organizational performance. Estimating a true cost of data errors within an organization can be very difficult, but the impact of poor data quality is easy to identify. “These impacts include customer dissatisfaction, increased operational cost, less effective decision-making and a reduced ability to make and execute strategy” (Redman, 1998).

The impact of poor quality data on customer satisfaction and increased operational costs can be seen in everyday retail and corporate transactions. An example would be a sales organization that instituted a new “salesman’s briefcase” system. The system would track each sales person’s client contacts, sales leads, customer contact information, etc. The system would also be used to drive commission pay. The data converted into to the new system was highly prone to data errors. In many cases accounts were tied to the wrong sales associate. Customer contacts were associated with the incorrect account. Sales within the organization slowed dramatically as the sales force focused on cleaning the data in the new system.

Given a large portion of the sales force’s pay was tied to the accuracy of the data in the system, cleaning the data immediately became their top priority. The organization paid not only in terms of the effort needed to clean the data, but in lost sales and a dissatisfied customer base that was not being attended to by the sales force.

While poor data quality’s impact on decision-making and the ability to make and execute strategy may be difficult to measure, it is also easy to recognize. According to one executive “we spend about half our (decision-making) time just arguing about whose data is better” (Redman, 1998). This phenomenon is particularly pronounced in data warehousing and Enterprise Resource Planning (ERP) projects and systems.

A data warehouse (or smaller-scale data mart) is a specially prepared repository of data created to support decision making. “Providing high quality data to decision makers is the reason for building a warehouse” (Wixom and Waton, 2001). As seen in the Wixom and Waton study (2001), a high level of data quality is associated with a high level of perceived net benefits. If the underlying data can not be trusted and often is conflicting, how can it be used to drive business decisions and strategy?
ERP systems provide “two major benefits that do not exist in non-integrated departmental systems: (1) a unified enterprise view of the business that encompasses all functions and departments; and (2) an enterprise database where all business transactions are entered, recorded, processed, monitored, and reported” (Umble et al., 2003).

This unification of data into a single database places a premium on the accuracy of the data. Inaccurate data introduced by one department within the organization will now have a domino effect on the entire organization (Umble, et. al., 2003). Correcting existing data errors in source systems during the conversion process becomes a critical, albeit difficult process. As a senior project manager at a firm specializing in EPP system implementations put it, “Even when an implementation goes really well and we nail the entire project, data is still a serious problem.”

With the underlying critical need for clean, accurate and usable data, organizations and researchers alike have spent more than a decade looking for better ways to define and maintain accurate data. The reader is directed to Lee et al. (2002) for an overview of related research. This prior research has focused primarily on the taxonomy of data errors, the process for data cleansing and maintenance and the tools used in the data cleansing process. Despite this prior work, data cleansing efforts tend to be very difficult and quite costly to organizations.

This study will focus on organizations efforts to clean data needed to support business functions, both transactions and decision making. In particular it will examine the typical process taken to “cleanse” data during a conversion and how task dependent metrics are impacted by the make-up and experience level of the data conversion and cleansing team.

**LITERATURE REVIEW**

**Dimension of Data Quality**

Much of the prior research to define data quality or information quality (IQ) has focused on defining the multiple dimensions of information quality. In general IQ dimensions can be grouped into four categories (Lee et al., 2002):

- Intrinsic IQ – Information has quality in its own right
- Contextual IQ – Information should be considered within the task at hand
- Representational and Accessibility IQ - Systems should provide access to information in a way that is easy to understand and manipulate.

**Assessing Data Quality**

It is important when determining the quality of data within an organization, to review the data through the lens of the user. “If stakeholders assess the quality of data as poor, their behavior will be influenced by this assessment” (Pipino et al., 2002). This study will adopt this user-centric focus and define data or information quality as “data that are fit for use by data consumers” (Wang and Strong, 1996).

Data quality assessments can be segregated into task-independent and task-dependent metrics. “Task-independent metrics reflect states of the data without the contextual knowledge of the application, and can be applied to any data set, regardless of the tasks at hand. Task dependent metrics, which include the organization’s business rules, company and government regulations, and constraints provided by the database administrator, are developed in specific application contexts” (Lee et. al., 2002).

Given the definition of information quality as data that are fit for use by the data consumer, task dependant metrics are vital. For example, an organization that chooses to implement an ERP Benefits module to automate retirement calculations could have a very different opinion of their data before and after the implementation:

- Prior to the ERP implementation many processes and functions are executed manually. For example when an employee initiates retirement, a retirement specialist from the benefits team is likely to complete the pension calculation manually. In order to complete this process the specialist would gather needed data from payroll, HR, etc. In this black box world of the manual process the user would have given a high quality data rating.
- Once the pension calculation is automated, the same data is needed in a standardized format within the ERP system. In the post-conversion world where retirements are initiated and processed on line, holding the process up while a retirement specialist tracks down needed data would likely lead to a frustrated employee and a retirement specialist that is not satisfied with the state of their data.
When assessing the state of data quality within an organization, both subjective and objective measures must also be considered (Pipino et. al, 2002). Subjective measures deal primarily with the data consumer’s perception of the data quality. These subjective measures can be captured with the use of a questionnaire. As mentioned earlier, these subjective measures are important as they drive user behavior. The most straightforward objective measure is a simple ratio. “The simple ratio measures the ratio of desired outcomes to total outcomes” (Pipino et. al, 2002).

**Data Complexity**

When completing a data conversion, cleansing, or integration project as seen in many data warehouse or ERP implementations, the cleansing team must determine the complexity of the data that will be received from the source systems. This research proposes that the following items drive this complexity:

- The total volume of data as measured by the number of records in the source systems,
- The number of data elements being integrated or cleansed,
- The number of sources of data that will be utilized and
- The number of non-automated sources of data.

In addition to the volume of data, data complexity of the source data is driven by the understandability and usability of the data storage system as well as redundancy of data across systems. If there is a large amount of redundancy of data in various source systems it will require additional data integration activities and increase the complexity of the source system data.

**Data Quality Drivers**

This research proposes that the primary drivers of target data accuracy in a data conversion and cleansing project are the data quality of the source systems and complexity of data received from the source systems. If an organization is implementing a new ERP system and conducting a cleansing project as part of the implementation the first step in the project would be to assess the current state of the data.

If there is only a single source of data, that is easy to access and understand, and the data within the source system is high quality, the target system will have high quality data. Unfortunately, clean data with low complexity is seldom the starting point of a data cleansing project. As the quality of the data declines or the complexity increases other factors, such as tooling, advanced analytical techniques and team experience, play an important role in the data cleansing project.

Tooling tends to be most effective improving task independent measures of data quality. There are several tools in the marketplace that can be used to cleanse specific domains such as name or address data or to complete duplicate record elimination (Rahm and Hai Do, 2000).

To improve task dependent measures of data quality advanced analytical techniques can play a vital role. There are many approaches to data analysis, but data profiling and data mining are often used. Data profiling focuses on instance analysis such as data type, length, value range, discrete values, variance, uniqueness, typical string values, etc. Data mining efforts includes clustering, summarization association discovery and sequence discovery (Rahm and Hai Do, 2000). The information gained from this analysis can be used to generate highly sophisticated mapping and cleansing rules.

Given the task dependent nature of data quality, it is proposed here that the cleansing team’s knowledge, experience and ability would significantly influence the outcome of the cleansing project. A review of current software development literature reveals that experience within the same system leads to productivity enhancement for an individual programmer and within programming teams (Boh et al, 2007). This same study found that team productivity was enhanced not only by experience within the same system, but also within related and similar systems. In fact experience with related systems had a greater impact on productivity at the team level than did experience within the same system.

**RESEARCH OBJECTIVE AND QUESTIONS**

This study looks to add to the data cleansing literature by analyzing the impact of the cleansing team’s experience on data quality. In particular, this study will build on the Boh et al. (2007) findings and determine the impact of team experience with the target system, the source system and similar systems on target data quality.
Building on this model, this study will test three primary hypotheses:

**H_{1a}:** Increased team experience with the source system will increase target data quality in data cleansing projects.

**H_{1b}:** The impact of team experience with the source system will be greater for highly complex data sets or source systems with extremely poor data quality.

**H_{2a}:** Increased team experience with the target system will increase target data quality in data cleansing projects.

**H_{2b}:** The impact of team experience with the target system will be greater for highly complex data sets or source systems with extremely poor data quality.

**H_{3a}:** Increased team domain knowledge will increase target data quality in data cleansing projects.

**H_{3b}:** The impact of team domain knowledge will be significantly greater for highly complex data sets or source systems with extremely poor data quality.

![Figure 1. Data Quality Success Drivers and Moderators](image)

**METHODODOLOGY**

This study will employ a combination of methods in order to triangulate and confirm findings. The primary method employed will be a review of project archival data of nearly 60 conversions executed within a single firm in the past two years. This will include a review of the issue and defect tracking system for the conversion and cleansing project as well as a review of the defects created and tracked post conversion.
The archival review will also include the data conversion requirements documentation, conversion development specifications and conversion reconciliation reports. Through this archival data the research team will quantify the team experience, source data accuracy, source data complexity and target data accuracy. Surveys will be conducted to measure team experience and user perception of data quality. A more detailed explanation of each variable follows:

**Source Data Accuracy**

Source data accuracy will be measured using the conversion team’s pre conversion profiling and edit reports. These reports detail the state of the data as received by the conversion team including the total number of records with missing or incomplete data, the number of records that fail to meet formatting standards as well as the number of records that do not pass context specific edits.

Each error will be categorized and given a severity rating from one to three based on the impact the error would have on ongoing processing if not corrected. A pre conversion data score will then be calculated by summing the severity rating of each error. This pre conversion data score will be assessed in conjunction with the total number of records to assign a source data accuracy rating of high, medium or low.

Data quality must also be measured through the eyes of the user. If the ultimate data user does not believe the data is of high quality, it will impact his use of the system (Pipino et. al., 2002). For this reason a survey instrument will also be employed to measure the conversion team’s assessment of the source data quality. The conversion team’s perception of the source data quality will be considered in the context of the quantitative data accuracy rating to determine the final source data accuracy rating.

**Source Data Complexity**

Source data complexity will be measured using the conversion data requirements, development specifications and team analysis meeting notes. The requirements documentation will detail the total number of sources, the number of sources that have overlapping or competing records as well as the structure and schema of the source data.

As with data accuracy, data complexity is also best examined through the lens of the user. If the data is complicated and difficult for the user to understand, the conversion will be more difficult to execute. The review of project archival data will be used in conjunction with the survey results to assign a source data complexity rating of high, medium or low.

**Target Data Accuracy**

Target data accuracy will be measured using three sources of data. First the team will review the number of records flagged for manual processing at conversion due to known data defects. This count will be considered in relation to the total number of records in the target data. Next the team will review the number of processes that are stopped or hit processing edits due to data in the first three months following conversion. Finally the issues and defects logged in the first three months following the conversion will be examined to identify data related defects. This information will be used to assign a target data accuracy rating of high, medium or low.

A survey instrument will also be employed to measure the ongoing team’s assessment of the source data quality. The ongoing team is responsible for processing transactions using the conversion data and the ultimate user of the target data. The ongoing team’s perception of the target data quality will be considered in the context of the quantitative data accuracy rating to determine the final target data accuracy rating.

**Team Experience**

A survey instrument will be used to elicit the number of month’s experience each team member had with the source systems prior to the conversion as well as the number of months experience each had with the target system and other systems in the same domain. Follow-up interviews with the conversion team lead will be conducted in order to evaluate overall team proficiency with the source systems, target system and the conversion tool set in general.

**RESEARCH STATUS**

A review of literature pertaining to data accuracy, data complexity, data cleansing, data migration, data maintenance and experience based learning in software development is underway. The target research organization has been contacted and the terms and conditions for access to organizational data are being negotiated.

At the conference the authors will present a research in progress report on the initial findings of the study including insights gained during the initial phases of the field study, any additional drivers uncovered by the research team, etc.
REFERENCES


Modeling IT Security Investment in Target Group of Similar Firms: a Control Theoretic Approach

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ABSTRACT
Criminal-hacker nexus leads to a 2 step target selection process, which begins with a short list of firms with similar information assets from which the hacker finally picks up that firm which has the weakest defense. This translates into a scenario where firms with similar information assets engage in a veiled race so as not to appear as the soft target in the focus group. In this work we propose a duopolistic model and utilize a differential game framework to analyze the IT security investment decisions of two firms who find themselves in such a short list of hacking targets and must compete dynamically on their IT security investments to reduce the risk of being breached. We provide the steady state (singular region) analysis of the differential game for two firms with symmetric and asymmetric parameters. Our model exhibits that hacker learning and firms’ security investment efficiency have opposite effects on the two equilibrium outcomes of interest, namely, the security level and the security investment rate. As hacker learning improves (security investment efficiency increases), the security levels and security investment rate of the two firms move apart (closer).

Keywords
IT Security, IT Security Investment, Control Theoretic Approach, Optimal Control in IT Security

1. INTRODUCTION
Profitable association with criminals has quite transformed hacker motivation to attack unauthorized computers. Motivations like gaining swaggering rights, exhibiting technical skills and enjoying playful thrills have given way to purely criminal, gain-seeking behavior as dictated by the criminals, who now engage hackers for stealing information assets of value. Also, severe commoditization of Credit and Debit Card numbers, in terms of open availability and high volume of supply in the black market, have driven prices so low that cyber criminals have now been compelled to revise their game plans. Single sign-on login credentials for organizations (e.g. Citrix log-in access based on SSO) and FTP accounts now-a-days fetch premium prices; healthcare related information as well as email exchanges are now traded for high gains1. Another popular hacking target in the face of the current downturn in the global economy is intellectual property; stealing proprietary marketable information assets is cheaper than creating them through painstaking initiatives in innovation2.

We pose this interesting question at this point: ‘Given that hackers now work for the criminals, how does this nuance the security landscape in which a firm must defend its IT assets?’ Unfortunately, there is no straightforward answer to this question, and there are no obvious insights available from the extant research in IT security. In order to explain such nuanced IT defense, we argue that the intent and the modus operandi of hacking activities need to be explained from 2 angles: first from the perspective of the principals of the hacking attacks, namely the criminals, and then from that of their agents, i.e., the hackers. Consider a criminal intending to steal the Citrix SSO log-in access of a medical practice into a large healthcare provider network/repository:

(a) The malevolent intent of a criminal in cyber crime stems from his/her downstream contacts and accomplices to utilize the derived information to buy/sell illegal drugs or set up fake web-based drug stores. (Similarly, a stolen SSO access to the Outlook express of an equity research analyst is a prized possession to criminals having skills in pump and dump schemes, because they can now utilize the Outlook access to analyze the exchanges of the official e-mails of that stock analyst.) As a result, the malevolent intent of the criminals, in view of their strengths in downstream activities, segregates defending firms into disparate target groups of firms who possess similar information assets. The development of such target groups of firms is also supported by a large section of the IT security practitioners in the US: about a fifth of those respondents who suffered one or more kinds of security incidents confirmed that they had suffered a targeted attack aimed exclusively at their organization, or organizations within a small subset of the general population (CSI survey 2007). In mid-July 2007, The

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Washington Post reported attacks on the computers belonging to the U.S. federal government, contractors and companies in the transportation industry. A report from Message Labs also suggests that narrowly targeted attacks are becoming more popular (www.DarkReading.com April 18, 2007).

(b) Criminals employ hackers to gain the access to the information asset. For our examples in point-1 above, the skills that the criminal would look for in a hacker are in terms of penetrating fortified network perimeters and hijacking ports, including gaining FTP accesses. However, hackers tend to compromise/access the specified information asset by spending the lowest amount of effort in order to maximize his/her return. This incentivizes a hacker to further select a soft target in the first set of target victims which was separated by the criminal’s intent (point-1 above). Hackers achieve this intermediate goal by scoping their potential victims’ defense systems through footprinting, fingerprinting, information enumeration and dry runs.

In view of (1) and (2) above, certain considerations tend to emerge for the defender of a cyber attack. **First,** a firm needs to assess its information assets in terms of their unauthorized sale/use, and then ascertain the group of firms from where a potential hacker could access such similar assets. For example, an inherent security issue for both Facebook and MySpace is the presence of third-party applications (http://www.eeweek.com, Dec17, 2008). **Second,** having identified the target group that it belongs to, a firm needs to competitively invest in IT security such that it can offer relatively higher resistance to a hacker than a comparable firm, in order not to appear as the soft target in the group of similar firms. In other words, a firm needs to harden its IT security only enough to deter and divert a potential abuser, who would then gravitate to a softer target that may require relatively less effort to compromise. That relative strength in defense can divert hackers to the less prepared/secured firm is evidenced in reality. In a sample of 18 financial firms, a 2004 study by the Financial Services Authority (FSA) of UK found that hackers routinely preferred smaller financial firms who also exhibited lower levels of security investments/preparedness.

Finally, as a result of the above shift in attack dynamics, firms with similar information assets (from the criminal’s perspective) are now likely to find themselves as competing targets for hackers. In this work, we analyze the investment strategies of such similar firms in their endeavor not to appear as the soft target of a hence identified target group. In particular, here we propose a duopolistic model of competing IT security investment between two firms in the same target group. Our adoption of a stylized duopoly model brings out managerial insights that are important, relevant and timely, but keeps our analytics tractable. We choose a control theoretic approach for our analysis because of our intention to analyze the relative investments of the firms on a continuous time profile.

The contribution of this work is two-fold. We provide a model for the nuanced IT security defense in view of the established fact that hacking activities are quite criminalized today. This helps us analyze the implicit competition among similar firms’ IT security investments facing a scheming hacker. Secondly, we analyze such competition in IT defense within a framework of differential game, and utilize control theoretic approach in the continuous time. To the best of our knowledge, none of this has been done before. Significantly, our work brings out the facts that hacker learning and IT investment efficiency play major roles in the way they determine the level of comparative investment in firms’ IT security investment: we exhibit a dilution effect on the investment of the firms as investment efficiency increases as well as a spreading out effect on firms’ investment as hacker learning increases because of the experiential gains of the hacker from the scoping and hacking activities.

In what follows, we briefly review the relevant literature in Section 2, present the notation and the analysis of our model in Section 3, and provide our concluding remarks in Section 4. This is a research in progress where we plan to analyze a central planners’ solution and compare the investment levels of the firms between the regimes of parochial and coordinated IT security investment.

### 2. LITERATURE REVIEW

Our current work relates to the interdependence of IT security investment among target firms, and here we provide a brief review of the closely related literature. Research in the economics of information systems literature address investments in IT security. Gordon and Loeb (2002) analyze how security vulnerabilities moderate firms’ IT security investments, which Tanaka et. al. (2005) empirically corroborates. Varian (2002) identifies existence of free riding behavior in firms where he views IT security in the light of public good being provisioned by private entities. Kunreuther and Heal (2003) analyze this interdependence of firms’ IT security, and characterize the free riding behavior. Hausken (2006) analyzes IT security investment as impacted by firms’ interdependence, income, and substitution effects; and later (Hausken (2007)), substitutability and complementarities of IT security investments. Ogut et al. (2005) differentiate security investments between technological controls and cyber insurance instruments and show general complementarity between these instruments. Bohme et. al. (2006) show that correlated cyber risks may create deficiencies in the supply of suitable cyberinsurance instruments, while Bandyopadhyay et. al. (2009) argue that IT managers face implicit losses leading to perceived contract overpricing in the demand side of cyberinsurance products. Sharing of Information about IT security/breaches have also been studied to analyze interdependent IT security investments: Gordon, Loeb, and Lucyshyn.
Liu and Bandyopadhyay (2003) show that sharing security information reduce firm’s incentives to invest in IT security, while Gal-Or and Ghose (2005) argue that IT security investments and information sharing could also feature as strategic complements. The study of differential games was initiated by Isaacs (1965) with applications to warfare and pursuit-evasion problems. A control theoretic approach to solve differential games has been utilized in several works (Sethi et. al 2000), Dockner et. al (2000) yet remained limited to advertising and military games to investigate simultaneous Nash equilibria, and later to investigate Stackelberg equilibria in Supply Chain scenarios.

3. THE MODEL AND ANALYSIS

The differential game in our model is set up in the backdrop of duopolistic competition between Firms A and B in their bid not to appear as the preferred target for an attacking hacker. Each of these firms possesses similar information assets which is the subject of interest to a criminal. In order to compromise the information asset, the criminal engages a hacker, who in turn attempts to optimize her own efforts during the process of compromising the above information asset. In the following paragraphs we first present our assumptions and notation, before we present the objective function that the players attempt to minimize. Next, we present the Hamiltonians, propose the non-singular solutions, and discuss their analytical tractability for singular solutions. Finally we present the singular solutions of our model first under further assumption of symmetry between the firms (analytical), and then we relax this specific assumption of symmetry and present a numerical analysis.

3.1 Assumptions and Model

Firstly, we assume that firms A and B are substitutable to each other from the hackers’ point of view, and that the hacker has the capability to assess the vulnerability level of the firms utilizing standard scoping activities, including those of foot and finger printing tactics over the Internet. In other words, after scoping activities, the hacker can compare the relative vulnerability levels of the firms, and channel more hacking attempts toward the softer target. We present below the notation used in our model and analysis.

\[
\begin{align*}
    x_A(t) & : \text{The vulnerability level of firm } A \ (B). \text{ This is defined as the probability of breach given an attack by the hacker.} \\
    N(t) & : \text{The aggregate attacking traffic at time } t \\
    L_A (L_B) & : \text{Loss suffered firm by firm } A \ (B) \text{ from a realized breach} \\
    S_A(t) (S_B(t)) & : \text{The rate of IT security investment by firm } A \ (B). \\
    S_{\text{max}} & : \text{The maximum rate of IT security investment by either firm } A \ (B) \\
    \lambda_A (\lambda_B) & : \text{The current value adjoint (shadow) variable} \\
    r & : \text{The discount rate, assumed same for either firm } A \ (B) \\
    \beta_A (\beta_B) & : \text{The investment efficiency parameter of firm } A \ (B) \\
    \rho & : \text{The time rate of increase in vulnerability of a firm as a reflection of the Hackers’ learning effect, assumed same for either firm } A \ (B)
\end{align*}
\]

Table 1: Notation Used in Our Analysis

Secondly, we assume that the proportion of hacking attempts targeted at firm A and B at any instant as \( h(t) = \frac{1+x_A-x_B}{2} \) and \( (1-h(t)) = \frac{1+x_B-x_A}{2} \)which preserves the aggregate hacking rate and the relative impact of the vulnerability levels of the firms. A firm’s security level depends on the security investment of that firm, vulnerability levels \( x_A(t) \) and \( x_B(t) \) are functions of \( S_A(t) \) and \( S_B(t) \). Consequently, the state equations are:

\[
\begin{align*}
    \dot{x}_A &= -\beta_A S_A(t)x_A + \rho, \quad x_A(0) = a \\
    \dot{x}_B &= -\beta_B S_B(t)x_B + \rho, \quad x_B(0) = b \quad (1)
\end{align*}
\]

Thirdly, we assume that firm A (B)’s losses due to penetration/breach is an increasing function of the amount of attacking attempts on the firm A (B). Lastly, the discount rate \( r \) captures the current value of summated investments for a firm in our infinite-horizon model. Firm A’s objective is to minimize the losses from breach through IT security investment, and thus Firm A solves (Firm B solves the analog problem): \( \text{Min} \int_0^\infty \left( \frac{1}{2}N(t)(1+x_A-x_B)x_A L_A + S_A(t)e^{-rt} \right) dt \) where \( x_A L_A \) is the
expected loss of firm A from one attacking attempt, and \( N(i)(1 + x_B - x_A) / 2 \) is the amount of attacking traffic at firm A. Firms A and B’s objective functions can be rewritten as

\[
\begin{align*}
\text{Max} \left\{ \int_0^\infty \left[ -(1/2)N(i)(1 + x_A - x_B)x_A L_A - S_A(i)e^{-\alpha t} \right] dt \right\} \\
\text{Max} \left\{ \int_0^\infty \left[ -(1/2)N(i)(1 + x_B - x_A)x_B L_B - S_B(i)e^{-\alpha t} \right] dt \right\}
\end{align*}
\]

(3) (4)

3.2 General Analysis

Firstly, the current-value Hamiltonians for these firms, based on the state equations (1) and (2), and the objective functions (3) and (4), can be written as

\[
H_A = -(1/2)(1 + x_A - x_B)x_A L_A + \lambda_A \rho - (1 + \beta_A \lambda_A x_A)S_A
\]

\[
H_B = -(1/2)(1 + x_B - x_A)x_B L_B + \lambda_B \rho - (1 + \beta_B \lambda_B x_B)S_B
\]

(5) (6)

Where \( \lambda_A \) and \( \lambda_B \) are the current-value adjoint variables for firms A and B respectively.

From (5) and (6), the Hamiltonians are linear in the control variables \( S_A \) and \( S_B \), and we have the following bang-bang and singular solution form for \( S_A \) and \( S_B \).

<table>
<thead>
<tr>
<th></th>
<th>( S_A )</th>
<th>( S_B )</th>
</tr>
</thead>
<tbody>
<tr>
<td>To be Determined</td>
<td>if (- (1 + \beta_A \lambda_A x_A) &lt; 0)</td>
<td>if (- (1 + \beta_B \lambda_B x_B) &lt; 0)</td>
</tr>
<tr>
<td>( S_{max} )</td>
<td>if (- (1 + \beta_A \lambda_A x_A) &gt; 0)</td>
<td>if (- (1 + \beta_B \lambda_B x_B) &gt; 0)</td>
</tr>
</tbody>
</table>

The controls in the singular region are required to satisfy the following conditions (7).

\[
(H_1)_{S_i} = 0, \quad \text{and} \quad (H_1)'_{S_i} = d(H_1)_{S_i} / dt = 0, \quad i = A, B
\]

As for the current-value adjoint variables \( \lambda_A \) and \( \lambda_B \), we also have the following equations.

\[
d\lambda_A / dt = r \lambda_A - \partial H_A / \partial x_A = r \lambda_A - (-x_A L_A + x_B L_B) / 2 - \beta_A \lambda_A S_A
\]

\[
d\lambda_B / dt = r \lambda_B - \partial H_B / \partial x_B = r \lambda_B - (-x_B L_B + x_A L_A) / 2 - \beta_B \lambda_B S_B
\]

(8) (9)

Solving equations (7) - (9) and (1) - (2), we have

\[
-r + \beta_A L_A x_A^2 - \beta_A L_A x_A x_B / 2 - \rho / x_A = 0
\]

\[
-r + \beta_B L_B x_B^2 - \beta_B L_B x_A x_B / 2 - \rho / x_B = 0
\]

(10) (11)

where \( x_A \) and \( x_B \), the singular levels of firms’ vulnerability, are the solutions of the above two equations. Since (10) and (11) do not yield closed form solutions, we separately discuss the symmetric and unsymmetrical cases below.

3.3 Symmetric Firms

The symmetric case assumes equality between corresponding parameters of the two firms. When \( L_A = L_B = L \) and \( \beta_A = \beta_B = \beta \), we have \( \hat{x}_A = \hat{x}_B = \hat{x} \), which is a solution of \( \beta L \hat{x}^2 / 2 = r + \rho / \hat{x} \). From (1) and (2), both \( \hat{x}_A \) and \( \hat{x}_B \) are positive constants, thus in the singular period, \( \hat{S}_A = \hat{S}_B = \hat{S} = \rho / (\beta \hat{x}) \), i.e., both firms make identical and constant rate of security investment in the singular region. In the pre-singular region, for firm A, if (i) \( a > \hat{x}_A \), (i.e., the initial vulnerability level is higher than that in the singular level), then \( S_A = S_{max} \); (ii) if \( a < \hat{x}_A \), then \( S_A = 0 \); and (iii) if \( a = \hat{x}_A \), then \( S_A = \hat{S}_A \). The pre-singular region solutions for firm B can be derived in a similar fashion. Also, in the symmetric case, \( d \hat{x} / dL < 0, d \hat{x} / d\beta < 0, d \hat{x} / d\rho > 0, d \hat{S} / dL > 0, d \hat{S} / d\rho > 0 \), and \( d \hat{S} / d\beta < 0 \). Below we summarize the above results.

4 Discrete controls at either Maximum controlling force or Complete absence of any controlling force, no intermediate levels are optimal.
Proposition 1:
If the two firms are symmetric, then they both make the same constant rate of security investment in the singular region.

Proposition 2:
The vulnerability level of each firm increases if 1) the Loss from a Breach decreases, 2) the security investment efficiency decreases, or 3) the hackers’ learning effect increases.

The singular level of security investment rate of each firm increases if 1) the Loss from a Breach increases, 2) the security investment efficiency decreases, or 3) the hackers’ learning effect increases.

3.4 Asymmetric Firms
In the asymmetric case, we conduct numerical analysis due to the difficulty of obtaining analytical results. The baseline values of the model parameters as assumed are $\beta_A = 1$, $\beta_B = 2$, $L_A = 100$, $L_B = 300$, $\rho = 0.6$, and $r = 0.1$.

3.2.1 Impact of Security Investment Efficiency on Security: In this subsection, we choose the baseline values for all the parameters except for $\beta$. Here we take $\beta_A = \beta_B = \beta$, and vary the value of $\beta$ from 0.1 to 10. Consistent with our results for the symmetric case, each firm’s vulnerability level goes down as security investment efficiency improves (Figure 1). Firm B, which has a higher loss of a breach (i.e., $L_B > L_A$), has a lower vulnerability level in the singular region.

![Figure 1: The Impact of Investment Efficiency ($\beta$) on the Vulnerability Levels of Firms](image1)

![Figure 2: The Impact of Investment Efficiency($\beta$) on the Security Investment Rates of Firms](image2)

The difference between the vulnerabilities of the two firms (i.e., $\hat{x}_A - \hat{x}_B$) goes down as well, as the security investment efficiency improves. This indicates that an improvement in the security investment efficiency may dilute the difference of firms’ vulnerability in the singular region, suggesting a relatively more balanced attacking traffic, since the amount of attacking traffic is a function of the difference of the two firms’ vulnerability levels. Similarly, the improvement of the security investment efficiency also dilutes the difference of firms’ security investment rates in the singular region (Figure 2).

3.2.2 Impact of Hackers’ Learning Effect on Security: In this subsection, we choose the baseline values for all the model parameters except for $\rho$, which we vary from 0.1 to 1.

![Figure 3: The Impact of Hackers’ Learning Effect ($\rho$) on the Vulnerability Levels of Firms](image3)

![Figure 4: The Impact of Hackers’ Learning Effect($\rho$) on the Security Investment Rates of Firms](image4)
We conveniently substitute $M_i = \beta_i L_i$, and define $M_i$ to be the Efficiency-Loss parameter for firm $i$, $i \in \{A, B\}$. Note that both firms’ vulnerability levels increase as hacker’s learning effect increases (Figure 3), which is again consistent with our findings in the symmetric case. Note that the firm with the lower value of Efficiency-Loss parameter is more insecure. Interestingly, the gap between the vulnerability levels of these two firms increases with Hackers’ leaning. This happens because the firm with higher value of Efficiency-Loss parameter tends to secure its systems more effectively, and thus is less sensitive to hackers’ learning effect. This ‘spreading-out’ effect in the gap of firms’ vulnerability levels result in a higher proportion of attacking traffic target the firm with a lower Efficiency-Loss. We also observe a similar ‘spreading-out’ effect in Figure 4, where the gap between the security investment rates of these two firms increases as hackers’ learning effect increases. Also note that, the firm with lower Efficiency-Loss parameter has a higher security investment rate (Figure 4), a result that reflects that the security investment efficiency chosen for that firm is relatively lower.

4. CONCLUDING REMARKS:

We have employed a differential game approach to examine how two firms on a substitutable short list of hacking targets compete dynamically on IT security investments to reduce the risk of being breached. We have shown analytically how the firms’ security levels and investment rates change with model parameters in the case where two firms are symmetric. In the asymmetric case, we have shown that hacker learning and the security investment efficiency have a spreading-out effect and a diluting effect, respectively, on the security levels and security investment rates of the two firms. The analysis of our model provides guideline for managers to strategically plan their security investment rates at a particular time and estimate their security levels effectively in a relative sense that occurs in a dynamic, competitive environment of the modern business. There are several interesting issues that are worth studying in the future research. For instance, we propose to study the optimal security investment paths from a central planer’s perspective, compare IT security investments under individual and coordinated decision regimes and also identify an effective coordination scheme for the two firms when the social solution offers more beneficial levels of IT security defense for the firms under consideration.

References


DECISION VARIABLES WITHIN REVERSE LOGISTICS

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ABSTRACT

This paper addresses a gap in the Lambert model of supply chain management through refining the link between the returns management process and the overall strategy of a supply chain firm by addressing the decision as to which reverse logistics activity to pursue. Current literature is sparse in this area and existing decision support systems (DSS) do not specifically address this problem. In order to determine what variables should be considered in such a DSS, recent DSS and simulation literature that addresses decision making within reverse logistics was reviewed. The author compiled a listing of 60 different variables spanning six broad categories, which identify areas for further research, gives researchers a comprehensive listing of variables to consider, and that can be analyzed in further studies to create a disposition decision framework and corresponding DSS.

The views expressed in this article are those of the author and do not reflect the official policy or position of the United States Air Force, Department of Defense, or the U.S. Government.

Keywords

Reverse logistics, decision support system, simulation, variable, remanufacturing, closed loop supply chain

INTRODUCTION

Reverse logistics (RL) is a multi-billion dollar business in the United States (Stock, Speh, & Shear, 2002). Accordingly, the decisions made within this area can significantly affect a firm’s bottom line. In order to assist industry decision makers and academics alike, researchers continue to create decision support systems (DSS) and simulations in order to quantitatively measure the implications of the rather unstructured decisions presented by reverse logistics. The goal of such research is to create standardized, optimized, programmed decisions in areas that have received little attention until recent years. One such decision involves how to recover the greatest amount of value from a returned product. This decision explores which disposition option will generate the most value for the firm, given its environment and circumstances. Research suggests that end-of-life product disposition can take four forms: a product can be reused, upgraded (remanufactured, refurbished), recycled, or disposed of (Prahinski & Kocabasoglu, 2006; Rogers, Lambert, Croxton, & Garcia-Dastugue, 2002; Staikos & Rahimifard, 2007).

The disposition decision is significant and has the opportunity to generate (or cede) sizeable profits. It is estimated that companies spend over $35 billion on reverse logistics activities in the United States each year (Pogorelec, 2000). Accordingly, initiating a disposition option without understanding the potential pitfalls and second-order ramifications can be detrimental. For example, supply chain capacities must be evaluated and market analysis must be completed to determine if the activity is not only profitable, but feasible. However, making an informed disposition decision can create competitive advantage through differentiation, thus maximizing profits.

The Lambert model of supply chain management conceptually integrates many business processes across the supply chain (Croxton, Garcia-Dastugue, Lambert, & Rogers, 2001; Lambert, Cooper, & Pagh, 1998). At the center of the model is the manufacturing organization, which is dissected into six basic departments found within such a firm: logistics, purchasing, production, research and development, finance, and marketing and sales. Products flow from initial suppliers, through the manufacturer, and then to the end user. The processes that are managed throughout this entire supply chain are: customer relationship management, supplier relationship management, customer service management, demand management, order fulfillment, manufacturing flow management, product development and commercialization, and returns management. Research which ties the returns management process into the strategic objectives of the supply chain is limited. Although some research investigates strategic and operational considerations for pursuing returns management activities (Rogers et al., 2002), the actual framework outlining these considerations has not been comprehensively investigated. Furthermore, decision frameworks in the literature are sparse and the factors considered vary considerably (Carter & Ellram, 1998; Dowlatshahi, 2005; Jayaraman & Yadong, 2007; Mollenkopf, Russo, & Frankel, 2007; Rogers et al., 2002; Skinner, Bryant,
& Richey, 2008; Tan & Kumar, 2006). Research is needed in this area to determine what factors must be evaluated from a strategic perspective when deciding whether or not to pursue a certain reverse logistics process.

The author did not find any DSS which specifically addresses support of the disposition decision at the strategic level. Such a DSS would be valuable to practitioners as it would provide a working tool that would aid in making this important decision. Academics would benefit from a strategic DSS as it would undoubtedly lead to further exploration of the variables and processes involved. However, before assimilating the strategic-level considerations into a framework and then creating a DSS in accordance with the framework, the operational variables which affect reverse logistics decisions must be evaluated in order to better understand the underlying factors involved. Finding and analyzing these variables will facilitate further research and lay the foundation for building a strategic framework.

This review investigates DSS and simulation literature as it applies to the product disposition decision within RL. The purpose of this review is to identify and assimilate the decision variables considered in the contemporary literature in order to create better understanding of the factors that affect the decision while identifying areas for future research. The output quality of any decision tool is a function of both its inputs and the methodology and accuracy of calculation. The published research in the emerging field of reverse logistics includes sound simulation and decision support methodologies and techniques. Correspondingly, the precision of these models require use of limited assumptions yet several variables. Inadvertently omitting any pertinent variable or holding incorrect assumptions (because of limited research within that assumption) can adversely affect the accuracy of such models, which may lead to inaccurate decisions. The outcome of this review identifies all variables considered within the scope of the literature. This provides future researchers a checklist of variables while highlighting assumptions that may deserve additional consideration. This also provides a platform for recognizing the absence or underutilization of variables that may require further investigation. Finally, this will provide insight into what variables should be included in a strategic disposition framework and, subsequently, a strategic DSS to facilitate disposition decisions.

METHODOLOGY AND SCOPE

The scope of this review was limited to articles that design, develop, test, or otherwise utilize a DSS or simulation in regard to facilitating a decision within reverse logistics. The literature from the top eight journals in Supply Chain Management, Management Information Systems, and Operations Management, as identified by Gibson and Hanna (2003), Rainer and Miller (2005), and Gorman and Kanet (2005) was first considered. The author originally began to review the top five in each discipline, but in order to incorporate the journals most applicable to the topic, the top eight in each field were included. In rank order by discipline, these journals are noted in Table 1, below:

<table>
<thead>
<tr>
<th>Supply Chain Management</th>
<th>Management Information Systems</th>
<th>Operations Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal of Business Logistics</td>
<td>MIS Quarterly</td>
<td>Transportation Science</td>
</tr>
<tr>
<td>Supply Chain Mgt Review</td>
<td>Information Systems Research</td>
<td>Operations Research</td>
</tr>
<tr>
<td>Transportation Journal</td>
<td>Mgt Science</td>
<td>Manufacturing/Service Operations Mgt</td>
</tr>
<tr>
<td>Intl Journal of Logistics Mgt</td>
<td>Journal of Mgt Information Systems</td>
<td>Mgt Science</td>
</tr>
<tr>
<td>Traffic World</td>
<td>Harvard Business Review</td>
<td>IIE Transactions</td>
</tr>
<tr>
<td>Intl Journal of Phys Dist/Log Mgt</td>
<td>Decision Sciences</td>
<td>Production and Operations Mgt</td>
</tr>
<tr>
<td>Journal of Supply Chain Mgt</td>
<td>Decision Support Systems</td>
<td>Journal of Scheduling</td>
</tr>
</tbody>
</table>

Table 1: Top Journals by Field

The top eight journals in each of these three fields yielded a total of 22 journals because of the interdisciplinary nature of both Management Science and Harvard Business Review. Logistics research spans a multitude of disciplines (Stock, 1997). However, the three selected disciplines encompass the vast majority of literature on the specific topic of disposition decision making in reverse logistics and are therefore thought to appropriately limit the scope of the search. Although searching only the top journals in a field may not render exhaustive results (Webster & Watson, 2002) a comprehensive interdisciplinary analysis of this nature requires a limited scope in the preliminary search of literature. Furthermore, this listing served more as a beginning reference than as a definitive boundary. Investigation into the literature revealed additional journal titles that pertain to this topic and were subsequently explored. These additional journals are discussed later in this section.
This review examined all applicable literature from 2000 through 2008. In their review of reverse logistics literature, Carter and Ellram (1998) propose that the first truly academic work (as opposed to practitioner-based work) in the field was not published until the early 1990s (Kopicki, Berg, Legg, Dasappa, & Maggioni, 1993; Stock, 1992). Their review also notes that the majority of literature throughout the 1990s was exploratory in nature, offering little theoretical grounding or quantitative study. Accordingly, the vast majority of quantitative reverse logistics literature is published after the year 2000, thus presenting a logical limit to the scope of this review. Furthermore, the author’s objective was to determine which variables are currently being utilized in the literature. This dictated that the review reach back far enough to provide an appropriate number of articles, but not so far as to lose contemporary relevance. The year 2008 was chosen as an upper limit so as to facilitate a comprehensive search of a selected period, thus limiting the possibility of accidentally omitting newly published literature within the stated scope of the review.

Each selected journal was searched via electronic database for the time period between January 1, 2000 and December 31, 2008. Broad keyword searches specific to each genre of journal reduced the risk of overlooking an article that meets the criteria. Keyword searches were tailored to each genre of journal in order to maximize effectiveness. For example, searching MIS literature for “logistics” helped to generate relevant results. Conversely, searching SCM literature for such a broadly-used term in the field produced thousands of hits. The keywords used for searching Supply Chain Management journals were: closed loop supply chain, end of life, return, disposition, reverse logistic, decision, model, simulation. The keywords used for searching Management Information Systems articles were: supply chain, logistic, decision, model, simulation. The keywords used for searching Operations Management journals were: reverse logistic, closed loop supply chain, return, decision, model, simulation. The initial keywords used for each genre of journal were broad in scope. The additional keywords were included after reviewing relevant keywords noted in the articles that were discovered using the broad terms. Of the many articles yielded in the search, titles, abstracts, and introductions were reviewed to find any literature that may include discussion of pertinent decision variables and considerations, unless the author creates a functional DSS or simulation. Articles not available in electronic format were requested through the university library. This process yielded 63 results – of which, the author was able to thoroughly read and make a final determination regarding adherence to established criteria of utilizing a DSS or simulation within reverse logistics for the purpose of decision making. Furthermore, rudimentary citation analysis directed the author toward other journals which, although not within the original scope, were deemed to be highly applicable to this review.

Much of the literature in this area seems to be in the Operations Management field, which prompted further exploration into more of these top journals. These journals are: Journal of Operations Management, International Journal of Production Economics, International Journal of Production Research, and Naval Research Logistics. In addition, the preliminary search in the Management Information Systems literature did not contribute many results. Therefore, the author searched the digital library within the Association for Computing Machinery portal in search of other relevant journal titles or conference proceedings within MIS. The same search procedure was performed on the additional journals and conference papers, which yielded a total of 15 additional articles. In sum, 79 articles were found, but only 45 articles met the specific criteria and were reviewed. The other 34 articles were dismissed because of various reasons, such as not being specific to reverse logistics, being qualitative in nature, not actually utilizing a DSS or simulation, or otherwise not being within the scope of this review. Because of the space limitations, a listing of all 45 articles used is not included in this manuscript. However, the reference list can be obtained from the author by request.

This paper serves to assimilate the work of each individual author in regard to searching for relevant decision variables. This documentation of variables will be available for use in future analyses while also identifying variables that may be under-utilized, omitted entirely, or requiring further research in order to include. The author investigated model explanations, discussion of variables, parameters, assumptions, and other applicable areas of the selected literature to extract and tabulate all variables that are considered in the respective article.

Limitations

This review includes only articles that develop, test, or otherwise utilize a DSS or simulation within reverse logistics for the purpose of facilitating a disposition decision or optimizing the disposition process. Although most reverse logistics articles include discussion of pertinent decision variables and considerations, unless the author creates a functional DSS or simulation, such articles are not considered. In short, quantitative articles were reviewed in lieu of qualitative or conceptual work because this author’s goal is to discover what variables are actually being used in quantitative research. Further, articles which meet the criteria of this review may have been missed in the initial keyword search. Of the articles discovered, some variables may have been overlooked or inadvertently omitted by the author in the review of the article and transcription and coding of the variables. The author assumes that all variables used in the respective research article are documented within the article. However, the sufficient number of articles and the large number of variables suggest that the limitations presented by this review do not affect its usefulness.
FINDINGS

A total of 60 variables are found within the literature. For ease of assimilation and to facilitate usefulness, the variables are listed in Table 1, in order of most utilized (top left) to least utilized (bottom right).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Times Used</th>
<th>Ratio</th>
<th>Variable</th>
<th>Times Used</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Demand</td>
<td>34</td>
<td>75.56%</td>
<td>New Item Inventory Level</td>
<td>6</td>
<td>13.33%</td>
</tr>
<tr>
<td>Product Return Volume/Rate</td>
<td>28</td>
<td>62.22%</td>
<td>Delays</td>
<td>6</td>
<td>13.33%</td>
</tr>
<tr>
<td>Remanufacturing Costs</td>
<td>28</td>
<td>62.22%</td>
<td>Recycling Costs</td>
<td>5</td>
<td>11.11%</td>
</tr>
<tr>
<td>Cost of Acquiring Returned Product</td>
<td>27</td>
<td>60.00%</td>
<td>Demand for Remanufactured Part</td>
<td>4</td>
<td>8.89%</td>
</tr>
<tr>
<td>Management Strategy/Policy</td>
<td>23</td>
<td>51.11%</td>
<td>Revenue from Recycling</td>
<td>4</td>
<td>8.89%</td>
</tr>
<tr>
<td>Inventory Costs</td>
<td>22</td>
<td>48.89%</td>
<td>Lot/Batch Size</td>
<td>4</td>
<td>8.89%</td>
</tr>
<tr>
<td>Disposal Considerations/Scrap Costs</td>
<td>21</td>
<td>46.67%</td>
<td>Labor Cost</td>
<td>3</td>
<td>6.67%</td>
</tr>
<tr>
<td>Leadtime</td>
<td>17</td>
<td>37.78%</td>
<td>Quantity Recycled</td>
<td>3</td>
<td>6.67%</td>
</tr>
<tr>
<td>Retail Price (New)</td>
<td>16</td>
<td>35.56%</td>
<td>Pattern of Recovery (Quantity and Type of Collection Location)</td>
<td>3</td>
<td>6.67%</td>
</tr>
<tr>
<td>Transportation Costs</td>
<td>16</td>
<td>35.56%</td>
<td>Legal Considerations</td>
<td>3</td>
<td>6.67%</td>
</tr>
<tr>
<td>Manufacturing Costs</td>
<td>16</td>
<td>35.56%</td>
<td>Outsourcing (3PL/4PL)</td>
<td>3</td>
<td>6.67%</td>
</tr>
<tr>
<td>Inspection Costs</td>
<td>14</td>
<td>31.11%</td>
<td>Environmental Considerations</td>
<td>3</td>
<td>6.67%</td>
</tr>
<tr>
<td>Remanufacturing Capacity</td>
<td>13</td>
<td>28.89%</td>
<td>Length of Time Customer Holds Product</td>
<td>3</td>
<td>6.67%</td>
</tr>
<tr>
<td>Sales Lost/Backorder Costs</td>
<td>13</td>
<td>28.89%</td>
<td>Cost of Capital</td>
<td>2</td>
<td>4.44%</td>
</tr>
<tr>
<td>Remanufactured Item Sales Price</td>
<td>13</td>
<td>28.89%</td>
<td>Safety stock</td>
<td>2</td>
<td>4.44%</td>
</tr>
<tr>
<td>Profit Margin of Remanufacturing</td>
<td>13</td>
<td>28.89%</td>
<td>Stocking points</td>
<td>2</td>
<td>4.44%</td>
</tr>
<tr>
<td>Product Lifecycle</td>
<td>13</td>
<td>28.89%</td>
<td>Service Level</td>
<td>2</td>
<td>4.44%</td>
</tr>
<tr>
<td>Fixed Costs</td>
<td>12</td>
<td>26.67%</td>
<td>Factory Location</td>
<td>2</td>
<td>4.44%</td>
</tr>
<tr>
<td>Return Quality</td>
<td>11</td>
<td>24.44%</td>
<td>Number of Remanufacturers</td>
<td>1</td>
<td>2.22%</td>
</tr>
<tr>
<td>Total Servicable Item Levels/Net Inventory</td>
<td>10</td>
<td>22.22%</td>
<td>Reverse Logistic Administrative Program Costs</td>
<td>1</td>
<td>2.22%</td>
</tr>
<tr>
<td>Manufacturing Capacity</td>
<td>10</td>
<td>22.22%</td>
<td>Processing Times (Remanufacturing/Manufacturing)</td>
<td>1</td>
<td>2.22%</td>
</tr>
<tr>
<td>Wholesale Price</td>
<td>9</td>
<td>20.00%</td>
<td>Packaging</td>
<td>1</td>
<td>2.22%</td>
</tr>
<tr>
<td>Number of OEMs (Monopoly, etc.)</td>
<td>9</td>
<td>20.00%</td>
<td>Discontinuation Price</td>
<td>1</td>
<td>2.22%</td>
</tr>
<tr>
<td>Existing Logistics Infrastructure</td>
<td>9</td>
<td>20.00%</td>
<td>Customer Segment (First Time or Replacement Customer)</td>
<td>1</td>
<td>2.22%</td>
</tr>
<tr>
<td>Salvage Value</td>
<td>8</td>
<td>17.78%</td>
<td>Value of Time</td>
<td>1</td>
<td>2.22%</td>
</tr>
<tr>
<td>Supply of Parts required for Remanufacture (Cost/Capacity)</td>
<td>8</td>
<td>17.78%</td>
<td>Penalty Costs of Uncollected Returns</td>
<td>1</td>
<td>2.22%</td>
</tr>
<tr>
<td>Market Size</td>
<td>8</td>
<td>17.78%</td>
<td>Sorting Policy</td>
<td>1</td>
<td>2.22%</td>
</tr>
<tr>
<td>Quality of Remanufactured Item</td>
<td>8</td>
<td>17.78%</td>
<td>Total Quantity of Items in Supply Chain</td>
<td>1</td>
<td>2.22%</td>
</tr>
<tr>
<td>Disassembly (Cost/Time)</td>
<td>8</td>
<td>17.78%</td>
<td>Total Cost of Reverse Logistics</td>
<td>1</td>
<td>2.22%</td>
</tr>
<tr>
<td>Remanufactured Item Inventory Level</td>
<td>7</td>
<td>15.56%</td>
<td>Forecast</td>
<td>1</td>
<td>2.22%</td>
</tr>
</tbody>
</table>

Table 2: Variables Used in Quantitative Reverse Logistics Literature

Close review of these variables suggests that the 60 individual variables can be grouped into six broad categories for consideration. In descending order of number of variables accounted for in each category, these are: supply chain and manufacturing (28), costs (15), market (7), customer (6), profits (2), and environmental/regulatory (2). Because of space limitations and lack of inter-rater reliability inherent in a single-author study, further discussion of these variables is not prudent for the purpose of this paper. Regardless, the inductive discovery of these six broad categories satisfies the purpose of this study. Further discussion of the findings will be included in a forthcoming study.

DISCUSSION AND RECOMMENDATIONS

As the findings suggest, very little literature was noted in regard to product reuse, recycling, or waste management. Investigation into what considerations are presented by these reverse logistics options is encouraged. In fact, most of the models reviewed are focused upon optimizing remanufacturing in some way; therefore, the variables concerning
remanufacturing issues are utilized more frequently. Although useful, this serves to only expand the knowledge base regarding one of the four disposition alternatives, leaving the other three behind in terms of academic development. Accordingly, the first recommendation for future research is to further develop areas of reuse, recycling, and waste management as they pertain to the reverse logistics process. This can be accomplished through the development of simulations or DSS and will lead to greater understanding of these disposition options while likely uncovering additional variables to be considered.

The results demonstrate a number of variables that are rarely used within simulations and DSS research in reverse logistics. This may be because these variables are not critical to RL. However, this may suggest that the implications of the variable within reverse logistics are not understood well enough and require further investigation. The second recommendation for future research is to take any variable with a low use rate and investigate it further by testing the effect of the variable on various reverse logistics processes. Specifically, quality in remanufacturing, 3PL/4PL considerations, legal considerations, and environmental considerations are research streams that have been previously identified as requiring more empirical study (Prahinski & Kocabasoglu, 2006). However, as this research suggests, there are many other variables within reverse logistics which may require further investigation.

The third recommendation is to conduct a similar study to this with a change in scope in order to discover what considerations exist within conceptual models and frameworks, qualitative research, or case studies. The author suspects that one may find additional variables that have been conceptually investigated but have yet to be included in empirical work. This information would provide researchers with a quantitative focus with additional variables to consider while providing researchers with a conceptual focus a better understanding of the variables being discussed in current research. Whether using the method described here or an unrelated methodology, further study is recommended to determine if any variables exist which are not addressed in this review.

Finally, the purpose of this study is to identify variables to consider when making strategic-level disposition decisions. This study identified 60 variables utilized as the operational considerations of recent DSS and simulation studies in RL. Further analysis of these operational considerations may suggest possible areas for strategic consideration. The author proposes that the most frequently used operational variables as determined by this study are also the most likely to be considered in a strategic framework. For example, the variable found to be used the most by this study, customer demand, will surely be a primary consideration within a strategic framework. However, in order to quantify these results and consider the use of all 60 variables, current decision frameworks and strategy-oriented reverse logistics literature must be reviewed to not only investigate whether or not these variables fit current models, but to determine if any of these variables can fill the gaps and/or expand upon existing literature in this area.

Future Work

This study is the first step toward a more broad research effort. In accordance with the recommendations above and in order to build upon this study, the author will validate the usefulness of the operational variable categories identified in the findings by reviewing literature of a strategic nature to determine if these categories are considered in strategic supply chain management literature. Upon validation and modification of these six general categories, the author plans to build a generalizable DSS to be used by supply chain professionals which will guide toward making the most advantageous RL disposition situation for their organization. The final outcome of the larger study is twofold. First, a gap in the Lambert theory will be filled which links organizational strategy to RL disposition decision making. Second, a useful tool (DSS) will be fashioned to assist practitioners in their decision making efforts.

CONCLUSION

Decision support systems and simulations require the inclusion of all relevant parameter variables if they are to produce accurate results. This paper identified 60 variables derived from the 45 articles reviewed. The articles reviewed offer complete, relevant simulations and DSS. Future authors will now have a depository of possible variables to consider – thus reducing workload and facilitating consistency. Recommendations for future research were suggested, which essentially call for searching for more variables and creating better understanding of the variables reviewed in this research. Although operational in nature, the articles encompass the many variables considered in reverse logistics processes. This provides insight into the possible considerations that may be taken into account when making strategic-level disposition decisions. Using the data gathered in this study in conjunction with existing frameworks, one could begin to hone a strategic framework with regard to strategic-level disposition decisions in an attempt to fill the gap presented by current understanding of the Lambert model of supply chain management.

REFERENCES


IMPLEMENTATION OF INFORMATION SYSTEMS INFRASTRUCTURES FOR SUPPLY CHAIN VISIBILITY

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ABSTRACT

Despite the considerable recognition of the importance of and the need for supply chain visibility, organizations experience difficulties in actually achieving such visibility. This may be attributed to two major reasons. First, organizations adopt different types of information technologies such as electronic data interchange or business-to-business for supply chain activities, which cannot communicate with each other without the adoption of many common “standards” for data representation and transmission. Second, organizations may have initially adopted supply chain information systems for different reasons such as mandates and may have engaged in selective “automation” of communication with its partners. Consequently, information systems within supply chain networks are “isolated” and organizations lose supply chain visibility. This study examines the implementation of supply chain management information systems at real-world organizations for achieving supply chain visibility. The findings of this study will be useful to organizations as they strive to implement solutions for supply chain visibility.

Keywords

Supply chain, information systems, visibility, adoption, and implementation

INTRODUCTION

Supply chain visibility has been and continues to be a major concern for organizations (Bradley 2002; McCrea 2005; Francis 2008). Although supply chain visibility has been defined and interpreted in different ways in research and practice, there is a general consensus that supply chain visibility is “the identity, location and status of entities transiting the supply chain, captured in timely messages about events, along with the planned and actual dates/times for these events” (Francis 2008).

While there is some recognition of what constitutes supply chain visibility and the medium for achieving supply chain visibility, organizations generally struggle to actually realize supply chain visibility in their operations. This is demonstrated by industry surveys by Aberdeen Group and Computer Sciences Corporation in which organizations report supply chain visibility as one of the top priorities for their operations.

This paper identifies the information systems issues that impede supply chain visibility and also illustrates ways in which organizations may design and implement their information systems solutions through case studies of real-world organizations. The lessons learned from these real-world cases would be useful for organizational managers looking for visibility in their supply chain operations and as they design and implement information systems solutions for supply chain operations.

EXTANT RESEARCH ON SUPPLY CHAIN VISIBILITY

Organizations typically participate in multiple supply chains – each chain made up of suppliers from multiple tiers offering raw materials and customers buying finished products – forming a network of supply chain relationships among their various partners (Jeyaraj and Sethi 2009; Lambert, Cooper and Pagh 1998). The network includes the focal organization, its direct partners (i.e. Tier I supply-side organizations and demand-side reseller organizations), and its indirect partners (i.e., partners of the direct partners, essentially Tier II supply-side organizations and demand-side customer organizations), and the ties between focal organizations and its direct and indirect partners. This suggests that supply chain visibility is to be understood from the perspective of the various linkages that make up the network of supply chain relationships (Lambert et al. 1998).

Supply chain visibility has been used interchangeably with the concept of information sharing (Swaminathan and Tayur 2003). Prior research has paid considerable attention to the concept of “information sharing” in the context of supply chains (e.g., Moberg et al. 2002). Arguing that information technologies enable greater information sharing, prior research has...
generally assumed that the adoption of information technologies by organizations can positively impact information sharing to the extent that organizations can derive benefits. Such benefits included quick response, efficient customer service, and data sharing (e.g., Aviv 2001).

An alternative approach has recognized that supply chain visibility goes beyond simple information sharing between organizations involved in supply chain relationships. For instance, prior research has recognized various mechanisms for supply chain visibility such as vendor managed inventory; collaborative forecasting and replenishment; and collaborative planning, forecasting, and replenishment (Waller, Johnson and Davis 1999; Raghunathan 1999; Aviv 2001). Supply chain visibility has been known to yield improvements in responsiveness, forecasting capabilities, and replenishment capabilities (Armistead and Mapes 1993).

Prior research has also argued that information sharing is an activity whereas supply chain visibility is an outcome of the information sharing activity (Barratt and Oke 2007). This particular view recognized the ability of organizations to achieve supply chain visibility through the sharing of useful and meaningful information (e.g., Mason-Jones and Towill 1998). There is recognition that mere information sharing and the availability of infrastructure mechanisms for information sharing are not sufficient conditions for achieving supply chain visibility.

Regardless of the conceptualizations of supply chain visibility, there seems to be a general assumption in prior research that the information systems used in supply chains are robust, compatible, and interconnected. This can be a severe limitation in understanding supply chain visibility since the information technology infrastructures and solutions come in various configurations, possess different capabilities, and deployed quite distinctively by organizations in the supply chain. This study examines the information systems that support supply chain operations and how they impact supply chain visibility.

INFORMATION SYSTEMS IN SUPPLY CHAIN NETWORKS

Organizations may have implemented various types of supply chain information technologies that possess different capabilities and require different organizational routines. Such technologies include electronic data interchange (EDI), inter-organizational systems (IOS), and business-to-business (B2B) systems (Son and Benbasat 2007; Iskander et al. 2001; Grover and Saied 2007). These systems possess unique capabilities (e.g., real-time vs. batch data sharing and transfer) and make use of different types of infrastructures (e.g., web vs. non-web networks). Consequently, information systems for supply chain activities at an organization and its partner may not be compatible with each other. The organizations may be able to overcome such compatibility problems between their information systems by adopting “standards” (for data representation and transmission). This is not a particularly straightforward activity as it depends on the number of partners and the number of different information systems at the various partners.

Furthermore, organizations may have adopted supply chain information technologies due to a variety of reasons such as mandates, capabilities, efficiencies, or bandwagons (Jeyaraj et al. 2006). While these reasons may not have been the sole contributors, such different reasons would have contributed to organizations doing one of the following: a) no automation with certain partners, b) one-way automation (i.e., either automatic upload or download of data, but not both) with certain partners, and c) two-way automation with certain partners. The effect of such different levels of automation is that organizations face “gaps” since not all partners have adopted or implemented supply chain information systems for the same reasons.

These two related issues – data representation or transmission standards and level of automation – quite extensively impede supply chain visibility for organizations. Without data representation or transmission standards, supply chain information systems at an organization and its partners become “isolated” and hence the organization is not privy to events at its partners and vice versa. Without automation or with only partial levels of automation, supply chain information systems at an organization and its partners would still be “isolated” resulting in problems with supply chain visibility.

These have important implications for organizations aiming to achieve supply chain visibility through the design and implementation of supply chain information systems. First, organizations need to understand the specific capabilities and infrastructures that are required for automating the link between their own information systems and their partners’ information systems. Second, organizations need to appreciate the specific ways in which they can actually alter their current capabilities and information systems to achieve supply chain visibility. This next section describes a real-world organization and how it strives to achieve supply chain visibility.

CASE STUDY

MFG-CO is a manufacturing company headquartered in a suburban region of Midwestern United States and has been in operation for more than 100 years. It manufactures a variety of custom products such as hoods, fenders, security cabinets, and
safes. The company also offers services such as metal fabrication, prototyping, and compressed lead time manufacturing. The production floor is located on a large facility (greater than 100,000 square foot) which is divided into different work centers such as fabrication, manufacturing, and prototyping.

MFG-CO uses an enterprise resource planning (ERP) system for maintaining data on its internal operations, including the production floor. The ERP system, Syteline, has been implemented with its full range of capabilities such that MFG-CO can track even the work-in-process inventory as they move through the various cells. To facilitate the most accurate data on current inventory, MFG-CO has installed wireless-enabled data capturing devices at vantage points all over the production floor, and has instituted processes whereby the production workers necessarily use the wireless devices to transmit the status of inventory at various cells to the Syteline software.

MFG-CO deals with more than 100 supplier organizations for its raw materials necessary for its production operations. Since these suppliers are typically small to medium sized enterprises, they typically do not have sophisticated information systems, such as ERP, for their internal operations. Hence, MFG-CO generally communicates its requirements for raw materials to suppliers via traditional channels such as the telephone, fax, or electronic mail.

MFG-CO sells its products and services to more than ten customer organizations. These customers include small, medium, and large organizations and a handful of them account for a vast majority of the volume of transactions. MFG-CO uses different methods to communicate data with its customer organizations. These include traditional channels such as the telephone, fax, and electronic mail for most of its customers and information technology (IT) channels for its major customers. The IT channels are generally based on EDI solutions implemented in different ways depending on the customer.

The major customers of MFG-CO are CUST-A, CUST-B, and CUST-C, and require MFG-CO to adopt different mechanisms of data transfer. While all of these interactions are based on EDI, the mechanisms are distinctly unique. CUST-A has its own EDI standard and requires MFG-CO’s data communications to be automated. Thus, MFG-CO has to prepare documents consistent with the EDI standard prescribed by CUST-A. CUST-B and CUST-C also have their own EDI standards; however, they do not require automated data communications from MFG-CO. Thus, MFG-CO has some flexibility over the data communication mechanisms.

MFG-CO thus faced severe problems with supply chain visibility. Not only was its communication and data sharing on the procurement side totally non-automated (and required MFG-CO to spend considerable amount of time and labor in keeping up with its suppliers), the communication and data sharing on the demand side was a mixture of no automation, partial automation, and full automation depending on its customers (which also required MFG-CO to expend considerable time and resources in managing different infrastructures and keeping up with its customers).

MFG-CO’s data communications with CUST-A, CUST-B, and CUST-C were based on a combination of different techniques. These included data files transmitted via electronic mail, data files shared using FTP (file transfer protocol), or data embedded in electronic mail communications. Following these, MFG-CO obtained hardcopies of the data files, which were then processed by its personnel — which included verification of the data, manual entry of the data into its ERP system, etc. This process was very time consuming (sometimes lasting three days) and prone to errors in data entry, resulting in considerable expenses in labor, losses in productivity, and lags in turnaround time to customers.

To address these problems, MFG-CO initially enlisted the help of VNDR-CO for achieving supply chain visibility. VNDR-CO offered two different SCM solutions: SCM-IT and SCM-NET.

- **SCM-IT** is a translator that can interface with a variety of internal IT systems maintained by organizations. It manages the transmission and receipt of business data between organizations. SCM-IT enables the separation of business data from the IT system such that organizations can migrate to newer IT systems without disruption. The business data is recast into the SCM-IT standard such that it can be transmitted to and received from organizations independent of their internal IT systems. SCM-IT is currently capable of interfacing with several ERP (enterprise resource planning) systems including Intuitive, Stelplan, EStelplan, SyteLine, Made 2 Manage, and QAD.

- **SCM-NET** is VNDR-CO’s own data transmission network which allows organizations to communicate with each other. It transfers the business data between organizations. While SCM-NET is capable of transmitting data in any format, it is optimized for the SCM-IT standard. SCM-NET offers 128-byte encryption technologies that protect business data during transmission. The service also includes several customer-oriented functions such as message archiving, tracing, managing data and access, etc. SCM-NET is an array of sophisticated servers that are typically commissioned on demand depending upon required capacity, thus providing a cost-effective data transmission alternative to organizations.
VNDR-CO presented several options to MFG-CO for supply chain operations as explained below based on Figure 1: Organizations (e.g. OrgA and OrgB) may choose to follow their own data standards but conduct the transmission through SCM-NET. Organizations (e.g. OrgA and OrgY) may choose to follow the SCM-IT data standard and conduct the transmission through SCM-NET. A SCM-IT-enabled organization (e.g. OrgY) may choose to communicate with another non-SCM-IT-enabled organization (e.g. OrgZ) through SCM-NET. Organization (e.g. OrgB and OrgZ) may choose to communicate with each other through SCM-NET without relying on any standard. Thus, MFG-CO had the option of using one or both SCM solutions.

Depending on the specific requirements of its major customers, MFG-CO requested VNDR-CO for two different interfaces. For outbound data to CUST-A, VNDR-CO customized its SCM-IT technology to interface with MFG-CO’s Syteline system and translated the relevant ERP data into CUST-A’s EDI standard. VNDR-CO then transmitted the CUST-A-compliant documents through SCM-NET. For inbound data from CUST-A, VNDR-CO’s SCM-IT system automatically translated CUST-A data into Syteline-compliant data. For CUST-B, VNDR-CO’s interface involved only the SCM-NET solution, which was used to transmit and receive data, since there was no requirement to fully automate data transfer. CUST-C instituted EDI recently and hence MFG-CO has not yet employed SCM solutions by VNDR-CO for engaging in EDI data transmission.

MFG-CO now has immediate access to information from CUST-A and complete visibility of that particular link. The SCM-IT and SCM-NET solutions from VNDR-CO allowed for near real-time sharing and availability of information to MFG-CO’s Syteline system. Further, the SCM-IT and SCM-NET solutions were configured for automatic data refreshes such that MFG-CO did not have to wait for data or to engage in manual capture and translation as it did before.

MFG-CO has also experienced significant improvements in its supply chain operations. First, the manual entry of CUST-A data into MFG-CO’s Syteline system and related processing for data verification has been minimized to a great extent. In rare cases where the transmitted data is not consistent with expectations or deemed to contain errors, MFG-CO’s personnel will engage in verification and manual data entry. However, the time involved in this process is now closer to three hours rather than three days in the early years. This has also yielded labor savings and improvements in turnaround time to customers. Second, due to the elimination of work related to the development and maintenance of the various EDI translation maps, MFG-CO is able to more efficiently allocate its personnel to other important activities within the organization that need more
attention. This also allows MFG-CO to operate with a small IT department. Finally, MFG-CO has the flexibility of maximizing and benefiting from its current capabilities by selectively extending or expanding its relationships to other partners on the supply chain.

CONCLUSION

This paper identified the potential problems for organizations when striving to achieve supply chain visibility and described the ways in which a real-world organization has implemented information systems infrastructures towards that seemingly elusive goal. While recognizing that multiple sites need to be examined before these findings can be generalized, this paper provides initial evidence of how organizations may begin to plan for and achieve supply chain visibility. The case reveals that organizations may need to manage a portfolio of information technology infrastructures to achieve supply chain visibility.

REFERENCES

FOCUSING ON THE LEARNER: CREATING A LEARNER-CENTERED IS COURSE

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ABSTRACT
There is a large and growing body of evidence that learner-centered education is more effective in terms of learning outcomes; it is also more satisfying for the learner. In a learner-centered course, the focus is on a partnership between the teacher and learner with shared responsibility for learning. The learner-centered approach fits well with the characteristics of “millennial” generation students, who are team-oriented, value continuous learning and seek frequent feedback. Learner-centered education has been recommended as a viable approach for information systems education for at least a decade, but applying these principles may be especially important today. Because learner-centered education matches well with the preferences of today's students, it is possible that applying learner-centered principles to IS courses can help address our enrollment problems. The purposes of this workshop are to introduce the concepts of learner-centered education, to illustrate how learner-centered concepts can be applied to information systems courses, and to help participants understand how they can employ learner-centered education in their courses. In addition, a methodology for developing learning activities will be presented and applied. The workshop will be highly interactive, and will use the principles of leaner-centered education. Participants will receive a link to workshop materials and additional resources.

Keywords
Learner-centered education, information systems education, millennial students

LEARNING OBJECTIVES
By actively participating in the workshop, participants will be able to:

• Compare and contrast learner-centered and instructor-led approaches to education
• Discuss the fit between learner-centered education and the “millennial student”
• Discuss how to develop a learner-centered environment for their course
• Apply a methodology to develop learner-centered activities

ACTIVITIES
The workshop will be evenly split between an interactive presentation and learning activities. The workshop will begin with an overview of learner-centered education and its relevance to teaching today's students. This is followed by a presentation of a methodology that can be used to develop learner-centered activities. Participants will then break into small groups and apply the methodology to develop one or more learning activities, which will then be shared with the rest of the participants. The workshop will conclude with a brief wrap up and open discussion.
WORKSHOP OUTLINE

1. What is learner-centered education?
   A. Definitions
   B. Principles
   C. Key characteristics
   D. Advantages

2. Building a learner-centered environment

3. Methodology for developing learner-centered activities

4. Group activity: Developing learner-centered activities
   A. Group time
   B. Sharing activities

5. Wrap-up and discussion

WORKSHOP LEADERS

Craig Van Slyke
Associate Dean for Academic Programs
John Cook School of Business
Saint Louis University

Dr. Van Slyke has over 15 years of university teaching experience, primarily in the area of information systems. He has published extensively on information systems education and has co-authored three IS textbooks. Dr. Van Slyke is on the editorial review board of the Journal of IS Education, and has held leadership positions in Southern AIS and AIS SIG:ED. In addition, he has applied the principles of learner-centered education to a variety of courses, including the introduction to IS course.

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ABSTRACT

Disturbances of the dynamic business environment represent a threat to the stability of the organizational behavior. However, principles of cybernetics provide some important insights according to which control systems capable of responding to the changes in the environment could be designed. In this investigation we argue that if the functionality of an Expert System (ES) is based on principles of cybernetics, then such ES can serve as a mean of controlling the stability of organizational behavior. We outline a possible set of functionalities of cybernetic-based ES, as well as a set of structural components constituting such ES.

Keywords
Complex systems, Organizational behavior, Expert system, Cybernetics

INTRODUCTION

A perspective on organizations as Complex Systems (CS) sensitive to the disturbances of the environment and characterized by periods of unstable behavior is by now well established (see Samoilenko (2008) for detailed overview). Recently, this perspective has also been extended to the context of organizational Information Systems (Samoilenko & Osei-Bryson, 2007; Samoilenko, 2008). But while previous inquiries offered a set of insights and implications regarding the functionality of the control system capable of managing the unstable behavior of organizations (Samoilenko, 2008), the past studies shed no light regarding the possible design of such system. Assuming that the behavior of an organization is controlled by means of an Expert System (ES), the results of previous studies provide some valuable guidelines outlining the functionality of ES in this regard. Namely, in order to manage the organizational behavior under the threat of external and internal disturbances, ES must establish communication channels, and then manipulate the flow of information through those channels across the organization (Samoilenko, 2008). However, at this point there are no insights regarding the possible architecture of such system; thus, it is not clear how ES should be designed in order to generate the information required for organizational decision making in the first place.

Consequently, the overall aim of this study is to obtain a set of insights regarding the possible structural design of an IS capable of controlling an organizational behavior, which we define as a pattern of activities associated with the maintenance of an organizational goal. In this study we rely on the assumption of relativity of an organizational goal, and focus on organizations that consider the states of their internal and external organizational environment in formulation of their strategies. Especially, we concentrate on the context where the achievement of an organizational goal is dependent on the level of performance of the organization, commonly measured in terms of the levels of the efficiency of utilization of inputs, effectiveness of the production of outputs, and efficiency of conversion of inputs into outputs. Resultantly, we limit the scope of our inquiry to productivity-driven organizations. Due to the relativity of the concepts of efficiency and effectiveness of the performance, productivity-driven organizations must take into consideration performance of the competitors. However, the dynamic nature of the business environment will cause the levels of performance of competing organizations to change over time, which will require reassessment of the values of the levels of effectiveness and efficiency of an organization relative to its competitors. There is an apparent link between significant changes in productivity of the competitors of an organization and changes in the business environment; if productivity of the competitors has improved, then a productivity-driven organization must respond with its own improvements in productivity.
Calls for improvements in the levels of effectiveness and efficiency are endemic to productivity-driven organizations. Significant changes in the levels of effectiveness and efficiency often require structural reorganizations (e.g., ERP, BPR, etc.) that bring about the periods of unstable behavior, which, if not managed, escalates and becomes chaotic (Samoilenko, 2008). Granted, some improvements in productivity do not require any structural transformations but simply call for a gradual type of improvements in the level of performance (e.g., TQM, BPI, etc.). However, in the absence of perfect scalability the appropriate course of action leading to improvements will change in time, primarily due to the law of diminishing returns. Resultantly, in a dynamic business environment any static model that used to describe the relationship between inputs and outputs will have a limited life span. In the absence of an adaptive mechanism that allows for discovering the new pathways for improving overall organizational performance, a productivity-driven organization will engage in the process of search and exploration, during which the number of the possible states or behaviors of an organization will proliferate. While periods of search and exploration are common to dynamic CSs, these periods also bring about the danger of a system not converging on the global maximum, and settling, instead, on multiple suboptimal local maxima. This outcome of search and exploration process will result in instability of organizational behavior and overall suboptimal performance of an organization.

Keeping the above mentioned in mind, we suggest that ES can fulfill the role of an adaptive mechanism capable of controlling an organizational behavior. However, in order to do so the design of ES must take into consideration two questions that an organizational control system must be able to answer, namely, relative to what context the performance of an organization is going to be measured?, and, second, what are the determinants of the given level of the relative performance? We express the research goal of this study by asking the following question: What constitutes robustness of the design of a ES capable of controlling the behavior of an organization? For the purposes of this investigation we provide the following definitions. First, we define a robust design of an ES as a design allowing for managing of the unstable behavior of an organization. Second, we define an unstable behavior of an organization as a behavior that is characterized by the perception of the loss of control (Samoilenko, 2008) over the process of the maintenance of the organizational goal caused by the precipitous increase in the number of the possible states or behaviors of an organization (Heylighen & Joslyn, 2001). The management of a behavior is defined as a capability to control the number of the possible states or behaviors of an organization. A state or a behavior of an organization, in turn, is determined by the set of constraints, and constraints serve the purpose of reducing the uncertainty about the system’s state or behavior (Heylighen & Joslyn, 2001). We define a constraint as an attribute or a set of attributes that accurately represent a particular dimension of the business environment in the model that an organization uses in its decision making process. In line with this definition we propose that an unstable behavior is unconstrained (e.g., the model is inaccurate), whether the stable behavior is constrained (e.g., the model is accurate). We note that a constrained model does not have to be complete. Finally, taking the abovementioned into consideration, we define ES as a medium that allows an organization to reduce the uncertainty about its state and behavior by means of providing a set of constraints utilized in the decision making process involved in the maintenance of an organizational goal. Resultantly, one of the functional requirements of ES is associated with the capability of creating the constrained (accurate) model of the business environment that is utilized by an organization.

The modern business environment is dynamic, and the assumption of instability of the internal and external environment is advantageous when designing ES, for such assumption will make its design more robust. The meaning of a dynamic environment from the perspective of ES is easy to decipher, for it implies the absence of a static set of constraints and relationships between constraints that are used in creating models of business environment used in the decision making process. Conversely, an embedded in the design assumption of stability, exemplified by fixed data and process models that describe constraints and the relationships between constraints, will greatly limit the capability of a ES, for any significant disturbance could render a set of constraints and their relationships obsolete and invalidate the embedded models.

However, traditional approaches to IS Development (ISD) are based on functionalism, and due to their reliance on stable models functionalist approaches do not allow for a dynamic discovery of new relevant constraints and disposal of the obsolete ones. Nor functionalist approaches allow for the dynamic adaptation and evolution of their design models. Furthermore, it is commonly accepted that a non-linearity of interaction between the system’s components, as well as the presence of emergent properties caused by a non-linearity, are some of the traits that characterize social systems, and it is those traits that are partially responsible for the complexity of an organizational behavior. But the traditional functionalist approaches to ISD employ reductionism to abstract away the complexity of not only the structure and behavior of an organization, but also the complexity of the relationship between an organization and its environment. Consequently, the use of the mainstream and extended functionalist methodologies in designing ES will result in systems that are inadequate for managing the periods of unstable behavior that are endemic to such CSs as organizations. New approaches are needed. We propose that second-order cybernetics, which emphasizes principles of autonomy, adaptation, and self-organization of CSs, could serve as a valuable vantage point from which important insights regarding the design and structure of ES capable of managing behavior of an organization could be obtained. Because the advocated perspective is context-independent, we
expect the results of this study to offer equally valuable insights regarding the design of the department-, firm-, industry-, or economy-level control systems.

We present our investigation as follows. Part One outlines the justification for our approach in the current investigation. Part Two offers an overview of the principles of the second-order cybernetics. Part Three translates the principles discussed in Part Two into the set of implications relevant for designing ES. Part Four Part suggests a set of structural components that could be utilized in the construction of the cybernetic-centered ES. Brief conclusion follows.

Part One: Justification of the Approach

We would like to offer a justification for why the principles of cybernetics could serve as a solid foundation of the structural design of ES; we argue that cybernetics can provide a suitable foundation for the following three reasons:

- First, domain of inquiry of cybernetics includes not only artificially engineered systems, but also naturally evolving ones. Organizations exemplify such engineered, yet evolving systems.
- Second, the subject of inquiry of cybernetics is goal-directed systems. Organizations are goal-directed systems, survival of which is dependent on achievement of the organizational goal.
- Third, the focus of cybernetics is on the use of information, models and control actions by goal-directed evolving systems. Organizations are such systems, and organizations actively use information, models and control actions in order to counteract internal and external disturbances that threaten stability of the goal-oriented behavior.

Based on this brief assessment of eligibility, the use of principles of cybernetics for designing control structures of organizations appears reasonable. However, despite fitting well for the purposes of our inquiry, cybernetics is not concerned with a structure of the control system, but rather with its function. For this reason, it cannot directly provide a prescriptive blueprint of what the possible design of a control system might look like. Therefore, we take a three-step indirect approach to outlining the conceptual design of ES. First, in Step 1 we offer an overview of the general principles of cybernetic systems. Second, in Step 2 we outline, based on the identified in the step 1 principles, a set of functionalities that a cybernetic system must possess. Finally, in Step 3 we offer a mapping of the identified in Step 2 functionalities to the design components that could be used in the design of ES.

Part Two: A Brief Overview of Cybernetics

Norbert Wiener was the founder of cybernetics as a field of study of the “control and communication in the animal and the machine” (Wiener, 1948); this came to be known as first-order cybernetics. According to first-order cybernetics, a system under study can be represented by its simplified model and perceived to be independent of its observer. Some cyberneticists felt that the emphasis in studying the systems must be placed on autonomy, self-organization, cognition, and the role of the observer in the modeling of a system; later this movement became known as second-order cybernetics (Heylighen & Joslyn, 2001). Being a complement, rather the alternative to its predecessor, second-order cybernetics (Von Foerster, 1960; Ashby, 1962) recognizes a system under study as an agent in its own right, actively interacting with the observer. The summary of the state-of-the-art in cybernetics, as well as a brief review of the subject which considers first, second order and a proposition for a third order cybernetics, can be found in Dubois (1995). And while in this paper we are concerned with second-order cybernetics, its principles are by now so firmly embedded in the overall foundation of cybernetics that it is appropriate to discuss this subject by simply referring to it as cybernetics, without making a clear-cut differentiation between first- or second-order cybernetics (Heylighen & Joslyn, 2001). Overall, cybernetic systems are characterized by complexity, mutuality, complementarity, evolvability, constructivity, and reflexivity (Joslyn, 1992); these characteristics and their interpretations are summarized below.

Table 1 General Characteristics of the cybernetic systems

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Interpretation of the Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complexity</td>
<td>Cybernetic systems are complex structures, with many heterogeneous interacting components.</td>
</tr>
<tr>
<td>Mutuality</td>
<td>Components of the cybernetic system interact in parallel, cooperatively, and in real time, creating multiple simultaneous interactions among subsystems.</td>
</tr>
<tr>
<td>Complementarity</td>
<td>Complementarity, which is brought about by the complexity and mutuality, refers to the irreducibility of the level of analysis to any one dimension.</td>
</tr>
<tr>
<td>Evolvability</td>
<td>Cybernetic systems tend to evolve and grow in an opportunistic manner, rather than be designed and planned in an optimal manner</td>
</tr>
<tr>
<td>Constructivity</td>
<td>Cybernetic systems tend to evolve and grow in size and complexity, while historically being bound to previous states.</td>
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</tbody>
</table>
Cybernetic systems can enter into the feedback of reflexive self-application, which may result in the reflexive phenomena of self-reference, self-modeling, self-production, and self-reproduction.

The fundamental principles of cybernetics are selective retention, autocatalytic growth, asymmetric transitions, blind variation, recursive systems construction, selective variety, requisite knowledge and incomplete knowledge (Heylighen, 1992); these principles and the interpretations of the principles are summarized in Table 2.

### Table 2 General principles of the cybernetics

<table>
<thead>
<tr>
<th>Principle</th>
<th>Interpretation of the Principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selective Retention</td>
<td>Stable configurations of the system are retained, while unstable ones are eliminated</td>
</tr>
<tr>
<td>Autocatalytic Growth</td>
<td>The stable configurations, which facilitate the appearance of configurations similar to themselves, will become more numerous.</td>
</tr>
<tr>
<td>Asymmetric Transitions</td>
<td>A transition from an unstable configuration to a stable one is possible, while the transition from stable to unstable configuration is not.</td>
</tr>
<tr>
<td>Blind Variation</td>
<td>The variation processes cannot identify in advance which of the produced variants will turn out be selected.</td>
</tr>
<tr>
<td>Selective Variety</td>
<td>The larger the variety of configurations a system undergoes, the larger the probability that at least one of these configurations will be selectively retained.</td>
</tr>
<tr>
<td>Recursive Systems Construction</td>
<td>BVSR (blind-variation-and-selective-retention) processes recursively construct stable systems by the recombining the stable building blocks.</td>
</tr>
<tr>
<td>Requisite Variety</td>
<td>The larger the variety of actions available to a control system, the larger the variety of perturbations it is able to compensate.</td>
</tr>
<tr>
<td>Requisite Knowledge</td>
<td>In order to adequately compensate perturbations, a control system must “know” which action to select from the variety of available actions.</td>
</tr>
<tr>
<td>Incomplete Knowledge</td>
<td>The model embodied in a control system is necessarily incomplete.</td>
</tr>
</tbody>
</table>

### Part Three: Implications of the General Principles of Cybernetic Systems for Designing ES

Based on general principles of cybernetics and their implications, summarized in Table 2, we can derive the set of implications regarding the required functionality of ES. The set of proposed functionalities provided in Table 3.

### Table 3 Implications of general principles of the cybernetics on the functionality of ES

<table>
<thead>
<tr>
<th>Principle</th>
<th>Implication of the Principle in Regard to the Functionality of ES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selective Retention</td>
<td>ES must not only be able to contribute to the development of the stable organizational configurations, but also to recognize them as such. For example, a successful product development process or a particularly productive organizational sub-structure must be identified (e.g., by using internal benchmarking?), and then retained within the organization.</td>
</tr>
<tr>
<td>Autocatalytic Growth</td>
<td>ES must promote the increase of the stable successful structures within an organization; this could be done through the process of the organizational learning utilizing knowledge-management systems.</td>
</tr>
<tr>
<td>Asymmetric Transitions</td>
<td>ES must be able to recognize the inferior solutions in advance, possibly by means of simulation and modeling.</td>
</tr>
<tr>
<td>Blind Variation</td>
<td>While ES might not be able to ensure the production of only successful configurations, it must be able to identify the obviously inferior ones. This could be done by means of using what-if analysis and scenario-building.</td>
</tr>
<tr>
<td>Selective Variety</td>
<td>ES must allow for a large variety of its own possible configurations; this could mean that ES should be characterized by a large number of independent components.</td>
</tr>
<tr>
<td>Recursive Systems Construction</td>
<td>ES must be able to construct stable systems by the recombination of the stable subsystems and elements, which suggests high cohesion and lose coupling of ES components.</td>
</tr>
<tr>
<td>Requisite Variety</td>
<td>ES must not be constructed for one specific purpose or with a predefined functionality; instead, it must constantly be in the process of growth and development.</td>
</tr>
<tr>
<td>Requisite Knowledge</td>
<td>ES must be able to select from multiple available actions an appropriate response to a particular event. This may mean that ES must have scenario-building capabilities, possibly utilizing modeling and simulations.</td>
</tr>
<tr>
<td>Incomplete Knowledge</td>
<td>ES must not function in the closed environment; instead, ES must be able to interact freely with not only the competitive environment of the firm, but with the global environment as well.</td>
</tr>
</tbody>
</table>
Part Four: Identification of the structural components of ES

A set of implications outlined in Table 3 suggests the presence of a concept that is central to a productivity-driven organization, namely, that of the superior stable configuration. In line with the principles of cybernetics, stability of the behavior a goal-oriented system is associated with presence of the successful stable configuration of the system. Given the goal of achieving a high level of efficiency of conversion of inputs into outputs, a superior stable configuration in the context of a productivity-driven organization may imply a model of conversion of inputs into output (input-output model) characterized by a high level of relative efficiency. Consequently, we put forward the following propositions:

Proposition 1: Stability of the organizational behavior of a productivity-driven organization is dependent on the presence of the stable input-output model.

Proposition 2: Accomplishment of the organizational goal of a productivity-driven organization is dependent on the creation and implementation of a stable input-output model characterized by the high level of relative efficiency.

Proposition 3: In order to control the behavior of a productivity-driven organization, ES must be able to create and identify superior stable configurations, represented by the input-output models characterized by the high level of relative efficiency.

Table 4 Possible interpretation of the functionality of ES in productivity-driven organizations

<table>
<thead>
<tr>
<th>Functionality of ES</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES must contribute to the development of the stable organizational configurations</td>
<td>Stable configurations allow for the presence of a consistent model depicting the process of conversion of inputs into outputs by an organization, in the form of an input-output model</td>
</tr>
<tr>
<td>ES must promote the increase in the stable successful structures within organization</td>
<td>Stable configurations promoted on the basis of the effectiveness and efficiency of conversion of inputs into outputs in such way, that every distinct consistent model is characterized by the distinct level of relative efficiency of conversion of inputs into outputs</td>
</tr>
<tr>
<td>ES must be able to recognize the inferior solutions in advance</td>
<td>Inferior solutions represent stable configurations characterized by lower levels of effectiveness and efficiency of conversion of inputs into outputs, while superior solutions represent stable configurations characterized by higher levels of effectiveness and efficiency</td>
</tr>
<tr>
<td>ES must allow for a large variety of its own possible configurations</td>
<td>A process of evaluation of the stability and quality of configurations is independent of the structure of input-output model representing a given stable configuration; single ES must be able to evaluate many configurations</td>
</tr>
<tr>
<td>ES must be able to construct stable systems by the recombination of the stable subsystems and elements</td>
<td>A process of evaluation of the stability and quality of configurations must rely on information-rich components that could be reused in new processes</td>
</tr>
<tr>
<td>ES must be able to select from multiple available actions an appropriate response to a particular event.</td>
<td>A process of evaluation of the stability and quality of configurations must allow for variations in inputs, outputs, as well as the variations in the process of conversion itself; ES must be able to identify not only the superior configurations, but also the factors that impact the quality of configurations</td>
</tr>
<tr>
<td>ES must not function in the closed environment</td>
<td>Stable configurations must be regularly assessed and re-assessed relative to the internal and external organizational environment</td>
</tr>
</tbody>
</table>

Keeping the relativity of the concept of efficiency in mind, the functionality of ES can be presented as encompassing two subsets of functionalities: internally-oriented and externally-oriented. Externally oriented functionality of ES is directed towards evaluating external competitive environment of a productivity-driven organization, as well as identifying the differences between the current state of the organization and the states of its competitors. Internally-oriented functionality, on the other hand, is directed towards optimization of the level of productivity of the organization, as well as towards identification of the factors impacting the efficiency of the input-output process. We suggest that outlined above functionality of ES could be implemented by means of using combination of parametric and non-parametric data analytic and data mining techniques, such as Data Envelopment Analysis (DEA), Cluster Analysis (CA), Decision Trees (DT), Neural Networks (NN), and Regression Analysis (RA). Table 5 provides a summary of how the above mentioned components could be utilized to implement the required functionality. In our future investigations we will demonstrate the detailed design of such ES, as well as provide the illustrative example of its functionality in the real-world context.

Table 5 Possible Structural Implementation of the Functionality of Cybernetic-Centered ES
### CONCLUSION

Results of our investigation suggest that a cybernetic-centered ES must be constructed from the collection of platform and implementation-independent components, which are highly cohesive and loosely coupled. Moreover, ES must be scalable, fluid, and be able to reconfigure itself in response to changes in the competitive and global environments. Furthermore, it must have scenario, model building, and simulation capabilities. Cybernetic-centered expert system must have multiple feedback loops and information inputs from the global and competitive environments. While the proposed in this paper complete design of ES capable of managing organizational behavior is still in its conceptual form, the parts of the outlined functionality have been implemented (e.g., Samoilenko & Osei-Bryson, 2007; Samoilenko & Osei-Bryson, 2010).

### REFERENCES

TESTING A SECOND-ORDER FACTOR STRUCTURE OF TEAM COGNITION IN DISTRIBUTED TEAMS

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ABSTRACT
The present research develops and tests a hierarchical model of the underlying behavioral processes of team cognition. Team cognition is represented as a second-order construct comprised of three first-order dimensions (team learning, team reflexivity, and team mental model). The proposed second-order construct was embedded in a nomological network as a mediator between collaboration mode (collocated vs. non-collocated technology-mediated) and task outcomes (team productivity and team interaction quality). The partial least squares approach was used to test the measurement and structural model. As hypothesized, team cognition significantly influenced team productivity and team interaction quality outcomes. Further, collaboration mode significantly improved team cognition through its specific effects on the team learning, team reflexivity, and team mental model first-order dimensions of team cognition. The results substantiate 1) the conception of team cognition as a multidimensional construct, 2) the use of second-order factors to address potential multicollinearity problems, and 3) use of higher-order constructs to present a more parsimonious model.

Keywords: hierarchical model, mental model, reflexivity, second-order factor, team cognition, team learning

INTRODUCTION
Team cognition has been defined as the ways in which teams process and use information (MacMillan, Entin, & Serfaty, 2004). More specifically, team cognition refers to a team-wide information sharing and exchange process, knowledge structures held by members of a team and the ways in which the team uses these knowledge structures. These knowledge structures are often referred to in the literature as schemas (e.g., Rentsch & Woehr, 2004) or mental models (e.g., Hinsz, 2004). Mohammed, Klimoski and Rentsch (2000) argued that there has been a significant amount of confusion and ambiguity about how to measure team cognition. Further, these measurement problems and inadequate conceptual development over how to measure cognitive structure at the group level were cited as significant reasons for lags in empirical research on shared mental model. This study argues that use of a higher-order construct that allows one to reflect team cognition from multiple perspectives could provide improved performance of relevant models. Accordingly, the main objective of this study was to develop and test a model that specifies a multidimensional structure of team cognition. The model’s conceptualization draws from the theories of team-based learning (Edmondson, 1999), team reflexivity (De Dreu, 2007), and team mental model (Klimoski & Mohamed, 1994).

MULTIDIMENSIONAL STRUCTURE OF TEAM COGNITION
As stated earlier team cognition has been referred to as the ways in which teams process and use information (MacMillan, Entin, & Serfaty, 2004). In addition, the team cognition literature has suggested that team mental models evolve and ultimately converge across time as a result of communication among group members (Rentsch & Woehr, 2004). Crossan, Lane and White (1999) presented a conceptualization of cognition at the individual, team and organizational level. Individual cognition was related to individual interpretation of information and environmental stimuli. Group cognition was marked by the sharing and evaluation of individually-held mental models and subsequent team-wide encoding of a mutually accepted mental model. Finally, integration and institutionalization of group level cognition outcomes is considered as organizational learning. Mohammed and Dumville (2001) noted that team cognition also involves the maintenance of a common ground (i.e. consensus on interpretation) and situation awareness (e.g., awareness of task progress/status, location of expertise, solution adequacy). Perception, learning and decision-making processes have also been associated with cognition in general. Edmondson (1999) described team cognition as the process of integrating multiple viewpoints within a psychosocial context that is characterized by psychological safety (i.e. encouraged participation where members are free from criticism of ideas). In summary, the varied conceptualizations of team cognition in the related literature consistently refer to behaviors associated
with team learning, team reflection on task strategy, task status and interpersonal interactions, and team mental model derived from an acquired shared understanding. Consequently, these three constructs or factors are assessed for their potential role in collectively defining a second-order construct defined as team cognition.

RESEARCH MODEL AND HYPOTHESES

Edwards (2001) proposed an integrative analytical framework based on structural equation modeling (SEM), which allows for the simultaneous inclusion of higher-order (multidimensional) constructs and their dimensions as latent variables. Figure 1 below presents the conceptual framework within which the hierarchical model of team cognition is tested. Based on the theory of affordances (Kirschner, Strijbos, Kreijns, & Beers, 2004) and social impact theory (Latane, 1981), the framework argues that collaboration mode will impact team productivity and team interaction quality outcomes through the mediating effects of a formative second-order factor team cognition. Further, team cognition is comprised of three first-order factors (team learning, team reflexivity, and team mental model) modeled as manifest variables or indicators.

**Figure 1. Research Model**

Collaboration Mode and Team Cognition

Kirschner et al. (2004), suggested that in order to achieve successful collaborative learning outcomes, a learning environment must provide 1) tools and procedures (*technological affordance*), 2) the opportunity to stimulate, facilitate, and maintain information exchange and idea evaluation (*educational affordance*), and 3) a cooperative, supportive, and trusting climate (*social affordance*). Social impact theory (SIT) suggests that behavior is guided by social influence derived from 1) salience or importance attributed to team members (*strength*), 2) time, spatial, or interpersonal distance among team members (*immediacy*), and 3) the quantity of influential sources (*numbers*). Recent research has also shown that relative to collocated teams, non-collocated technology-mediated teams inherently exhibit lower strength and immediacy effects and therefore encounter more negative team process behaviors such as withdrawal from participation (e.g., Blaskovich, 2008) diminished communication/information exchange (e.g., DeLuca & Valacich, 2006), lack of shared understanding (e.g., Miranda & Saunders, 2003), and intra-team conflict (e.g., Hinds & Mortensen, 2005). Further, the process losses inherent to non-collocated technology-mediated teams tend to create difficulty in assessing the current state of a task’s solution and execution plan alignment with task requirements and monitor any motivational or interpersonal problems that may arise (De Dreu, 2007; Edmondson, 1999). Consequently, the following hypothesis is proposed:

**HYPOTHESIS 1.** Teams working in a face-to-face collaboration setting should exhibit more effective team learning, team reflexivity, and team mental models than in a technology-mediated setting.
Team Cognition and Collaboration Outcomes

Effective team learning and accurate shared team mental models provide declarative and procedural knowledge that facilitates task execution, minimizes duplication of effort and facilitates synergy and efficiency which in turn promotes greater productivity. In addition, teams that are unable to adequately reflect on task status and alignment with task objective are likely to experience process losses, frustration, conflict, and distrust (Hoegl, Weinkauf, & Gemuenden, 2004). Team reflexivity can stimulate a process of shifting from bad to good ideas and problem solutions, and ultimately improved team performance (De Dreu, 2007) and can promote development of cooperative goals and minimize disconfirmation of expectations (Briggs, Reinig, & de Vreede, 2008) that result in a supportive and cooperative task environment (Tjosvold, Tang & West, 2004). Thus, the following hypotheses are proposed:

**HYPOTHESIS 2.** Improved team cognition will be positively associated with team productivity.

**HYPOTHESIS 3.** Improved team cognition will be positively associated with team interaction quality.

RESEARCH METHODOLOGY

To test the research model and hypotheses, a laboratory experiment was conducted to examine the effects of two different modes of team collaboration – face-to-face and technology-mediated collaboration. Forty-eight participants were drawn from a population of Management Information Systems undergraduate students familiar with the Systems Development Life Cycle approach to software design and knowledge of structured programming. The teams were required to enhance the functionality of a hypothetical university information system. The experimental task required each team to construct software design documentation that included (1) a hierarchy chart, (2) a list of function prototypes, and (3) pseudocode for each function identified as part of a solution to the problem.

Measures

The behavioral observation approach was used in assessing team learning, team reflexivity, and shared mental model by using three trained observer ratings of associated task-related and affect-related behaviors. Observer ratings can be superior to self-report data collection because it allows real-time measurement of dynamic and emergent behaviors and self-report data can be distorted due to affect and inaccurate recall. In providing their ratings, three trained observers used a rating scale that ranged from 1 (very low) to 7 (very high). The interrater agreement index for all scale ratings ranged from $a_{w(j)} = 0.85$ to $a_{w(j)} = 0.97$ indicating very good interrater agreement (Brown & Hauenstein, 2005). Scale items appear in Table 1 below.

The team productivity measure was determined by awarding one point for each correct specification of any data value of a specific data file, correct output and input data value of a program module (i.e., function or subroutine), and correct specification of program statement needed in a specific program module.

Measurement Model

To assess internal consistency reliability, convergent validity and discriminant validity of the construct measurements, the constructs’ composite reliabilities (CR) and the average variance extracted (AVE) were calculated using PLS. Regarding internal consistency (reliability), composite reliability scores for every construct (ranging from 0.874 to 0.975, as shown in Table 1) are well above 0.70, which is the suggested benchmark for acceptable reliability (Chin, 1998). Table 1 also indicates with the exception of one item-to-construct loading of 0.696 all of the items have loadings at 0.700 or above and the t-statistic for the item to construct loadings were all significant at $p \leq .01$. These results indicate that the measurement model has displayed both item internal consistency reliability and item convergent validity.

**Table 1. Composite Reliability, AVE, and Indicator Loadings**

<table>
<thead>
<tr>
<th>Construct and Item Level Values</th>
<th>loading</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Team Learning (Composite Reliability = 0.975; AVE = 0.908)</strong></td>
<td></td>
</tr>
<tr>
<td>TeamLearn1 Some team members were just listening without providing any verbal input</td>
<td>0.937</td>
</tr>
<tr>
<td>TeamLearn2 Team-wide consensus was confirmed before moving forward with an idea</td>
<td>0.977</td>
</tr>
<tr>
<td>TeamLearn3 All team members provided useful verbal input</td>
<td>0.926</td>
</tr>
<tr>
<td>TeamLearn4 Ideas were thoroughly discussed and evaluated among all team members</td>
<td>0.971</td>
</tr>
<tr>
<td><strong>Team Reflexivity (Composite Reliability = 0.894; AVE = 0.740)</strong></td>
<td></td>
</tr>
<tr>
<td>Reflexivity1 Frequent double-checking the work done by others is done right</td>
<td>0.946</td>
</tr>
<tr>
<td>Reflexivity2 Frequent double checking that the solution is meeting requirements</td>
<td>0.915</td>
</tr>
<tr>
<td>Reflexivity3 Team made obvious effort to create and maintain a positive climate</td>
<td>0.700</td>
</tr>
</tbody>
</table>
Discriminant validity is evidenced when all the loadings of the scale items on their assigned latent variables or construct are larger than their loading on any other latent variable. Table 2 below provides the correlations of each item to its intended latent variable (i.e., loadings) and to all other constructs (i.e., cross loadings).

Table 2. Indicator Loadings

<table>
<thead>
<tr>
<th>Item</th>
<th>Team Learning</th>
<th>Team Reflexivity</th>
<th>Team Mental Model</th>
<th>Team Interaction Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>TeamLearn1</td>
<td>.937</td>
<td>.580</td>
<td>.608</td>
<td>.628</td>
</tr>
<tr>
<td>TeamLearn2</td>
<td>.926</td>
<td>.661</td>
<td>.652</td>
<td>.685</td>
</tr>
<tr>
<td>TeamLearn3</td>
<td>.977</td>
<td>.698</td>
<td>.681</td>
<td>.713</td>
</tr>
<tr>
<td>TeamLearn4</td>
<td>.971</td>
<td>.659</td>
<td>.550</td>
<td>.641</td>
</tr>
<tr>
<td>Reflexivity1</td>
<td>.619</td>
<td>.946</td>
<td>.491</td>
<td>.672</td>
</tr>
<tr>
<td>Reflexivity2</td>
<td>.609</td>
<td>.915</td>
<td>.454</td>
<td>.570</td>
</tr>
<tr>
<td>Reflexivity3</td>
<td>.532</td>
<td>.698</td>
<td>.463</td>
<td>.613</td>
</tr>
<tr>
<td>MentalModel1</td>
<td>.719</td>
<td>.684</td>
<td>.943</td>
<td>.681</td>
</tr>
<tr>
<td>MentalModel2</td>
<td>.573</td>
<td>.427</td>
<td>.960</td>
<td>.556</td>
</tr>
<tr>
<td>MentalModel3</td>
<td>.590</td>
<td>.453</td>
<td>.976</td>
<td>.619</td>
</tr>
<tr>
<td>IntQual1</td>
<td>.608</td>
<td>.706</td>
<td>.467</td>
<td>.886</td>
</tr>
<tr>
<td>IntQual2</td>
<td>.336</td>
<td>.334</td>
<td>.662</td>
<td>.696</td>
</tr>
<tr>
<td>IntQual3</td>
<td>.765</td>
<td>.704</td>
<td>.526</td>
<td>.912</td>
</tr>
</tbody>
</table>

Table 3 below indicates that the AVE square roots that appear in the diagonal are larger than any correlation between the associated construct and any other construct (Chin, 1998; Majchrzak et al., 2005). This AVE analysis result and the item to construct loadings discussed above suggest that the measurement model displays discriminant validity.

Table 3. Latent Variable correlations and square root of AVE

<table>
<thead>
<tr>
<th></th>
<th>Team Learning</th>
<th>Team Reflexivity</th>
<th>Team Mental Model</th>
<th>Interaction Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team Learning</td>
<td>.953</td>
<td>.682</td>
<td>.860</td>
<td>.960</td>
</tr>
<tr>
<td>Team Reflexivity</td>
<td>.653</td>
<td>.542</td>
<td>.700</td>
<td>.714</td>
</tr>
<tr>
<td>Team Mental Model</td>
<td>.960</td>
<td>.644</td>
<td>.837</td>
<td></td>
</tr>
</tbody>
</table>

Note: square root of the constructs’ AVE appear in the diagonal

Structural Model

Using PLS Graph (Version 3.0 Build 1130), the structural model and hypotheses were assessed by examining path coefficients and their significance levels (Chin, 1998). The proposed model conceptualized three first-order constructs (team learning, team reflexivity, and team mental model) modeled as formative indicators (i.e. manifest variables) of the second-order construct – team cognition. Because PLS Graph (Version 3.0 Build 1130) does not directly permit the representation of second-order latent constructs, it was necessary to separately test the first-order constructs that formed the second-order
construct in a sub-model, and then use the resulting computed first-order factor scores as manifest indicators of the second-order construct that is later used in a separate model (Yi & Davis, 2003). Therefore, two sub-models were separately tested (see Figure 3 below): Sub-model 1 related the first-order constructs to their reflective indicators and determinants (collaboration mode), and Sub-model 2 related the second-order construct (team cognition) comprised of factor score loadings derived from collaboration mode effects to the remaining model variables (team productivity and team interaction quality).

![Figure 2. PLS Test Results of Research Model](image)

Figure 2 above summarizes the model-testing results. Supporting Hypothesis 1, collaboration mode had significant effects on all three first-order dimensions of team cognition: team learning ($\beta = 0.76, p < 0.01$), team reflexivity ($\beta = 0.50, p < 0.01$), and team mental model ($\beta = 0.74, p < 0.01$). The second-order factor, team cognition, had a significant effect on team productivity ($\beta = 0.83, p < 0.01$) thereby providing support for Hypothesis 2. Supporting Hypothesis 3, team cognition had a significant effect on team interaction quality ($\beta = 0.79, p < 0.01$). The proposed research model provided the best fit to the data (i.e. overall explained variance in the model) as compared to all other possible configurations (e.g., omitted paths, first-order factors only, etc.).

**DISCUSSION**

This study attempted to investigate the multidimensionality of team cognition. In testing the hierarchical model of team cognition, the study was successful in explaining the underlying mechanisms through which team cognition mediates the impact of collaboration mode on team productivity and team interaction quality. All three dimensions of team cognition were significantly influenced by collaboration mode. Moreover, the overall team cognition significant effect suggests that learning, reflexivity, and shared interpretation are essential for facilitating team productivity. In other words, in addition to facilitating information and transactions, collaboration mode also operates on team level cognitive functioning. Further, poor team cognition can give rise to frustration that result in poor interactions among team members.

The findings offer an extension to prior research on team cognition by extending the operationalization of team cognition. The results suggest that team cognition can be modeled as a second-order composite latent construct determined by three first-order factors (team learning, team reflexivity, and team mental model). The use of a second-order factor structure can enhance the conceptualization and estimation of team cognition models as a result of the capture of an overall representation of team cognition through the underlying commonality among its first-order dimensions. In addition, the multilevel conceptualization of team cognition allows for analysis at different levels of abstraction – overall team cognition or a specific underlying dimension. This suggests that hierarchical models offer both greater flexibility and parsimony in specifying model constructs. The use of team learning, team reflexivity, team mental model as a parsimonious higher-order construct takes advantage of their conceptual overlap (capturing multiple aspects of team cognition), while maintaining the unidimensionality of their measure.
REFERENCES


*(Because of page limitations, full references are available upon request)*
A CASE FOR USING THE BALANCED SCORECARD FRAMEWORK AT PROJECT STAGE-GATES

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ABSTRACT
IT project management is plagued by its inability to stop projects that ultimately fail. This persistent problem results in the loss of scarce resources and IT departments unable to generate full value for money invested. There is considerable evidence to suggest that information asymmetry is a significant contributor to this waste. The Balanced Scorecard is a framework that has been widely employed in business as a tool to translate the organizational vision into workable business plans and a framework for effective communication amongst stakeholders. Stage-gates are a widely-used method in new product development and they are gradually making inroads into software project governance. Using a model based on Balanced Scorecard and Stage-gates, this study proposes how their use in IT project governance can mitigate the effects of information asymmetry and thereby increase the likelihood of terminating an uneconomical project quickly.

Keywords
Balanced Scorecard, information asymmetry, IT project governance, Stage-gates

INTRODUCTION
The Standish Group’s Chaos Report 2006 indicated that 65 percent of Information Technology projects reach challenged or failed status each year (Rubinstein, 2007). In October 2005, one of Britain’s largest food retailers wrote off a $526 million supply-chain system and hired 3,000 additional store clerks to manually stock the shelves (Charette, 2005). In April 2005, the FBI gave up on its Virtual Case File (VCF) project after investing $170 million, leaving it with the same pre-9/11 case management system as before, and that system was five years more antiquated than when the VCF project began (Goldstein, 2005).

This paper will focus on the problem of unwarranted project continuation; continued support for a project that will fail to generate full value for the money invested. If managers always acted as completely rational economic actors, they would discontinue support for a project as soon as they perceived that it would end up with a negative economic return. This paper will not focus on the closely-related problem of IT project escalation in which “there is continued commitment and negative information” (Keil, 1995). In IT project escalation, the project does not stay on schedule and budget with the specified level of quality. Sometimes an escalated project can result in a good economic return, but with unwarranted project continuation this is never the case. Unwarranted project continuation would include a project that stayed within schedule and budget parameters while providing the product or service requested, but ultimately yielded a negative economic return to the firm.

Previous research has identified information asymmetry, one of the key problems identified within agency theory, as a significant contributor to the problem of project escalation (Keil, Mann and Rai, 2000). In information asymmetry, the agent has information not available to the principal. The standard measures taken by the principal to reduce information asymmetry involve closely monitoring the agent via regular reports and project status meetings (Müller and Turner, 2005). While these measures can be helpful, judging from the high levels of unwarranted project continuation, they are insufficient. What is needed is a mechanism with an emphasis on identifying projects that will fail to deliver a positive economic return so they can be discontinued as early as possible thereby avoiding wasted resources. This paper proposes an addition to standard project governance practices that is expected to reduce information asymmetry and thereby reduce the incidence of unwarranted project continuation.
BACKGROUND

The traditional approach to rational decision-making derived from economic theory assumes a firm's managers will reach decisions intended to maximize the profitability of their firms. Managers should invest resources in the projects expected to provide the greatest profits to the firm and then periodically evaluate the actual economic performance of those projects. They should continue the projects expected to be profitable and, to avoid losses, discontinue those expected to be unprofitable. However, in reality it is common to observe continued managerial support for projects that ultimately become unprofitable; an estimated 30% to 40% of all IS projects fail to meet their schedule, budget, and quality requirements, standard indicators of a project that will ultimately fail (Keil et al., 2000).

This research is grounded in agency theory with a specific focus on the problem of information asymmetry (Keil, et al, 2000, Austin, 2001). An agency relationship is a contract under which one party (the principal) engages another party (the agent) to perform some service on their behalf which involves delegating some decision-making authority to the agent (Jensen and Meckling, 1976). In the project governance context, the agent is the project manager charged with meeting the project goals set by the principal i.e., the executive sponsor of the project. In a larger sense, the principal could also be the firm with which the executive is identified. For the purposes of this research, the project sponsor will be called the executive; they have the resources at their disposal, as well as the decision-making authority to continue or discontinue a project.

In a principal-agent relationship, when the agent has private information and an incentive to shirk their responsibilities, they are likely to act in their own self-interest at the expense of the principal. A failing IT project is particularly prone to information asymmetry. In this situation, private information would take the form of the project manager (agent) having knowledge indicating the project is likely to fail to deliver a positive economic return to the principal (the firm). The project manager (PM) would have a personal interest in maintaining their reputation as a successful PM and not finishing a project would be almost certain to damage their reputation. Even though a project would yield a negative economic outcome for the principal, the PM’s career considerations are a strong incentive to shirk their responsibility to admit that the project should be discontinued. Given a PM with information asymmetry and an incentive to shirk their responsibilities to the principal, that PM would be likely to seek to continue the failing project at the expense of the firm. In a laboratory experiment, it was demonstrated that subjects were more likely to continue with a questionable project when they were manipulated to believe that they possessed private information about the project's prospects for success and that a decision to discontinue a project would damage their reputation and potentially harm their career (Harrison and Harrell, 1993). Prior research has determined that information asymmetry is a significant contributor to projects that are allowed to continue beyond the point at which they should have been terminated (Keil et al., 2000).

If a principal can closely monitor an agent's actions, a condition of information symmetry between the parties prevails. In this situation, private information would be less likely to do so because the principal would know the agent was shirking. In such an environment, it is in the best interests of the agent to discontinue a failing project because the principal will also know the project is failing.

Balanced Scorecard

One commonly-used mechanism for collecting and disseminating information is the Balanced Scorecard (BSC) framework (Kaplan and Norton, 1992). Managers using the BSC framework take into account multiple perspectives when decisions are made. The framework provides a system of checks and balances so that the major stakeholders in the firm and the four BSC perspectives (Financial, Customer, Process, and Learning & growth) are represented in decision-making. The adoption of BSC means every manager and executive of a firm routinely participates in multiple perspective decision-making (Kaplan and Norton, 1996). The emphasis on multiple perspectives and their communication among subject matter experts in each perspective would be expected to reduce information asymmetry as behaviors undertaken by agents within the firm to conceal private information are likely to be less successful than in a firm not utilizing BSC.

When a firm completely implements the Balanced Scorecard framework, every aspect of the firm is managed within it, including the Project Management governance of the firm. The Balanced Scorecard provides tools to facilitate multi-criteria decision-making by the key stakeholders of the firm. All activities of the firm are managed according to a balancing of the four major perspectives with this framework driving the information collection and dissemination practices throughout the firm. Every manager is judged and rewarded according to their functional area's performance relative to its' portion of the overall firm's Balanced Scorecard. In previous research, project management within a Balanced Scorecard framework has been shown to deliver better project performance results (Norrie and Walker, 2004).
Stage-Gates

Borrowed from the marketing realm, a popular mechanism for decision-making is Stage-Gates™, a process in which a new product must be vetted multiple times during the development process, from origin to completion. Stage-gates originated in response to an 82 percent failure rate for new product efforts (Cooper and Kleinschmidt, 1993). The benefits of Stage-gates have led to their incorporation into Project Management Frameworks such as PRINCE 2. Stage-gate decision meetings are held before the start of each project stage and a go/kill decision is made to determine if the project should continue. This normally will involve a few, relevant project stakeholders participating in the decision-making process. Numerous organizations have adopted Stage-gates for IT project governance and yet unwarranted project continuation has not been fully mitigated with resulting wastage of resources and falling behind the competition (Cooper, 2008). In a Stage-gate governance environment, if a project manager is withholding information about the project’s likely negative outcome, they will have to withhold that information at every Stage-gate until the project is completed. Given the career impact for a manager that is eventually found out, this process is likely to reduce the incidence of information asymmetry.

CONCEPTUAL MODEL

Balanced Scorecard is a framework that has been widely employed in business as a tool to translate the organizational vision into workable business plans and a framework for effective communication amongst stakeholders. By providing multiple sources and perspectives on project performance to the executive sponsor (principal), the BSC framework can reduce information asymmetry by taking away the agent's control over private information. In the application of the BSC to projects, a project can conceptually and simply be seen as a mini-company (Martinsons, Davison and Tse, 1999; Stewart and Carpenter-Hubin, 2001) and that company's goals must be kept in line with the overall corporate business strategy and the key stakeholder requirements.

The application of the Balanced Scorecard to IT project governance will involve:

1. Setting the project vision in line with the business goals of the organization.
2. Translating the project vision into measurable goals. The scorecard forces the stakeholders of the project such as the executive, the project manager, senior customer representative, the program management office (PMO) representative or portfolio manager and corporate finance to arrive at an agreement on the metrics they will use to operationalize their project vision. By cascading the overarching project goals into objectives and measures for each group, the project’s Balanced Scorecard provides a mechanism for alignment of all the project stakeholders and lays the foundation for effective communication among the stakeholders.
3. Feedback and Learning: This BSC perspective will ensure that previous projects contribute know-how to the current projects and that the firm's store of knowledge is enhanced through lessons learned in current projects to aid the firm in future projects. By supplying a formal mechanism for fact-based feedback and review, the Balanced Scorecard helps an organization foster learning and growth.

The proposed Balanced Scorecard metrics (Table 1) capture how well the project is being executed, and whether it is on course and on target. Poor performance on these metrics need not be a kill indicator, but a strong signal that the project and team could be in trouble, and that course corrections are needed.

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Finance</th>
<th>Customer</th>
<th>Process</th>
<th>Learning and Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role:</td>
<td>Financial Executive</td>
<td>Senior Customer Representative</td>
<td>PMO Representative</td>
<td>Program Manager</td>
</tr>
<tr>
<td>Key Questions:</td>
<td>Project within budget?</td>
<td>Project meeting customer requirements?</td>
<td>Key process parameters under control?</td>
<td>Project competencies and skills available? Project adding to corporate competencies?</td>
</tr>
<tr>
<td>Key Considerations:</td>
<td>- Estimated vs. actual cost - Expected costs vs. benefits</td>
<td>- Schedule - Functionality - Usability - Quality - Performance</td>
<td>- Productivity - Defect trends - Schedule variance - Effort variance - Process conformance</td>
<td>- Lessons learned - Training</td>
</tr>
</tbody>
</table>

Table 1: The Balanced Scorecard metrics of an IT project
Stage-gates in the Model

For an effective stage-gate system to work, prior research suggests the following guidelines (Cooper, 2008):

1. Governance roles must be carefully identified. The gatekeepers should be senior people in the business who own the resources required for the project leader and team to move forward. They are also people who can make the project go/kill decisions. The gatekeepers must be a small team, typically consisting of the business executive, the project manager, the senior customer representative, the PMO representative or portfolio manager, and corporate finance.

2. The gates must be associated with real project consequences. They should be used to reach a go/kill decision and used for resourcing if the project is continuing to the next stage.

3. Rules of engagement must be put in place. This ensures that all stakeholders/participants understand how they are to communicate and participate in the go/kill decision.

4. Gates must be lean and simple. The gates should not impose a high informational requirement from the project team members. To avoid information asymmetry, the information sources for the four perspectives should come from the team members roles associated with those perspectives (Table 1).

Figure 1: Use of the Balanced Scorecard at Stage-gates

There are numerous benefits of using Stages-gates in product management. Most best-practice product companies have implemented a robust idea-to-launch system, such as Stage-Gate®1 (Griffin, 1997; Cooper, Edgett and Kleinschmidt, 2002, 2005). The benefits of such a process have been well documented and many well-known companies, such as Proctor & Gamble, Emerson Electric, ITT, and 3M, have profited from using Stage-gates (Cooper 2008). In a study on the use of Balanced Scorecard in IT project alignment it was observed that using a BSC framework to make IT projects align with overall corporate strategy can possibly improve the traditional project deliverables: on-time, on-budget, and on-quality. These researchers found that, “using the BSC in project settings facilitates a wider perspective on project management successes and facilitates a team’s linking to a wider range of strategic performance indicators that it can use to appropriately develop a clearer project vision and to more clearly monitor and control individual project goals and objectives” (Norrie and Walker, 2004).

Summary of the BSC-Stage-Gate Model

The Balanced Scorecard with Stage-gates framework brings together the representatives of all four BSC perspectives in a format that provides independent sources of information to the decision-maker. These representatives will typically be subject matter experts with significant stakes in the project which should encourage them to ask the project manager the “hard questions” that might otherwise not be asked.

A Theoretical Example of the BSC-Stage-Gate Model in Practice

A major internal software development project at Company X has reached the threshold for the BSC-Stage-gate governance model supervised by the PMO and it has cleared the First Stage-gate. At each subsequent project stage-gate, the representatives of the four BSC perspectives, the project manager and the project's executive sponsor participate in a meeting.

Second Stage-gate: Financial and Customer issues

- The PM provides a BSC-relevant project status report to the assembled stakeholders. As part of this report, routine metrics are covered such as the project's progress relative to cost and schedule, and the software defect rate.
The Financial perspective representative points out that the project is 15 percent over budget, presenting a threat to its required positive economic return. The Customer perspective representative cautions that an early functionality milestone was missed.

The PM outlines a plan to reduce the project's spending rate later in the project. After the PM points out that key users have not previously been made available for functionality verification, the Customer perspective representative agrees to provide these users to assist the programmers in resolving functionality issues before the next Stage-gate is reached.

The Executive sponsor determines that the economic return is still positive and decides to continue the project.

Third Stage-gate: Process and Learning & growth issues

The PM provides a BSC-relevant project status report to the assembled stakeholders. The PM recommends the project's continuation according to plan.

The PMO (Process) representative highlights that the project's software defect rate of 0.2 defects per thousand function points is double the firm's standard for this point in a project. The Learning & growth perspective representative points out that a module that would provide a function that fits with an upcoming initiative should now be elevated in priority and fully resourced.

The PM explains that a key Quality Assurance (QA) tester was lost, leading to the high defect rate. As far as the Learning & growth-related module, the PM requests extra resources which threaten the project's budget.

The PMO identifies a QA tester that can be transferred from a project that is winding down. The tester will be shifted to this project soon after this Stage-gate meeting. Additionally, the PMO recommends the reuse of some code in the company's software repository to form the core of the Learning & growth-related module. The reuse of this code eliminates the need for an additional resource and helps keep the project within its budget.

Since this project will provide a positive economic return and contribute to an upcoming initiative, the Executive sponsor reaches a go decision, allowing the project to continue to the next stage.

Any one of the issues cited in the theoretical example above may not been brought to light for corrective actions without the combined BSC and Stage-gate framework.

CONCLUSIONS

Based on the discussions above and evidence from existing literature, this research proposes that the use of a combined Balanced Scorecard and Stage-gate framework is likely to provide more effective project governance than existing practices. The Balanced Scorecard framework and Stage-gates have been successfully implemented for IT projects independently of one another. This research recommends combining the two as a way to reduce information asymmetry with thorough, strategically-aligned, ongoing reviews of projects.

Proposition 1: Using the Balanced Scorecard framework at Stage-gates will reduce information asymmetry in project governance.

Proposition 2: Using the Balanced Scorecard framework at Stage-gates will improve the likelihood of early termination of projects that would otherwise yield negative economic returns.

Implications for Practice and Research

For IT project practitioners, the use of the Balanced Scorecard framework at Stage-gates will reduce information asymmetry and result in better project governance decisions. This will lead to early detection of projects that will not add economic value to the firm and enable executives to make informed and timely decisions for their discontinuation. The timely decisions to stop unwarranted project continuation will lead to reduction in waste of resources and result in IT delivering increased business value to the firm. Future research involving an empirically tested simulation game of this proposed model is planned.

Limitations for Practitioners

Previous research has indicated that a strict adherence to the Stage-gate process tends to discourage the development of novel, new products and to impair corporate learning (Sethi and Iqbal, 2008). As a result, a limitation of this research is that if project governance teams apply Balanced Scorecard to Stage-gates in a too-strict manner, it may discourage the introduction of novel, “game-changing” IT projects. This is a serious concern as novel IT projects are often those offering
the greatest risks and rewards. This also has implications for the proposed model’s Learning perspective of the Balanced Scorecard in project Stage-gates.

REFERENCES

REDUCING INEFFECTIVE CONTINUATION DECISIONS: A FRAMEWORK FOR PROJECT INFORMATION

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ABSTRACT

Effectiveness of project continuation/cancellation decisions is a major concern for both the researcher and the practitioner. Past research has studied the possible psychological causes of different outcomes. The equivocality of information has also been offered as an explanation. This paper combines these ideas into a framework to study decision outcomes revealing additional detail about the information used and factors involved in project continuation/cancellation decisions.

Keywords
Project Management, Escalation, Cancellation, Abandonment

INTRODUCTION

The ubiquitous use of project management techniques in Information Systems development is testified by its inclusion in lists of best practices for information systems development (Davenport, DeLong and Beers, 1998; Feeny and Willcock, 1998; Holland and Light, 1999). But use of project management, in and of itself, is not a strong predictor of project success (Boehm, 2000). Stories of failed projects often cite the wealth of project management data that was available during the life of the project (Verner and Evanco, 2005; Wateridge, 1995; Wateridge, 1998), showing that mere usage of project management techniques is not complete protection against project failure. For whatever reasons, some project managers don't use the available information or don’t use it correctly as evidenced by escalation scenarios (Keil, Rai, Cheney Mann and Zhang, 2003; Mähring and Keil, 2008; Sabherwal, Sein and Marakas, 2003), or cases of poor management (Pinto and Kharbanda, 1996). However the number of failed projects that have detailed and complete PM information is large enough to question whether some data is missing from common project management reporting practice.

One of the purposes of project management information is to provide an indication of the progress of a project in order to allow management to intervene in projects that deviate from plan. One of the means of intervention is project cancellation. Thus project management information should indicate when the project is in such a state that it should be cancelled. With an estimated 35% of projects being called “runaways” (Mahaney and Lederer, 2003) and cost overruns averaging 200% (Keil, Mann and Rai, 2000), clearly organizations are ignoring the indicators and/or there are deeper issues.

While past research has explored project abandonment (Ewusi-Mensah and Przasnyski, 1991), the impact of sunk cost effects and completion effects (see Keil et al., 2000), and the impact of goal incongruence and information asymmetry (Mahaney and Lederer, 2003) little, if any, research has explored the content of the information which is used in the decisions that result in the various outcomes. This leads to the primary research question for the study: What information allows some managers to make good project continuation decisions while others make bad project continuation decisions?

This study will discuss the question from the perspective of additional data that may be available to make project continuation decisions; is there a way to generate data that will more clearly indicate whether a project should be continued or cancelled? To accomplish this, a model is developed by working backwards from project status categorizations through the decisions and nature of the information which leads to the status. The model is then used as a map to seek information which when present contributes to improved decision making.

LITERATURE REVIEW

A review of literature surrounding project management decision and the errors that occur reveal three major streams of research.
Escalation

Escalation is ordinarily defined as increasing commitment to a failing course of action (Bowen, 1987). The phenomenon has been widely studied within the field of Information Systems Development (Keil and Flatto, 1999; Keil et al., 2003; Mähring and Keil, 2008; Pan, Pan and Flynn, 2004). Escalation is characterized by Information Systems projects that are continued well past a reasonable cancellation point. In most cases, escalation is viewed as a psychological phenomenon. A notable exception is Keil et al. (2003) in which constructs derived from project management literature are used to predict escalation in projects. This study views the predictive power of the Keil et al. (2003) study as an indication that other forces outside the psychological realm are at work.

In this study, escalation is not used as an explanation for projects that continue past the point where cancellation was reasonable. Instead, escalation literature provides a means to retrospectively declare a decision as incorrect. Due to the binary nature of the continue/stop decision, knowing that the decision to continue was incorrect demonstrates logically that the correct decision would have been to stop.

An additional finding from escalation literature is that decision makers are not always completely predictable users of information. One study determined that we can explain some escalation behavior through psychological theories such as self-justification, sunk cost effect, or completion effect (Keil et al., 2000). This study recognizes these factors and acknowledges the need to control for such situations.

Project Information

Past research has shown that the principal information used to assess projects is schedule conformance, budget conformance, and quality of the results (Atkinson, 1999). Additionally, the need for supplementary information beyond this classic information set for the purposes of decision making is acknowledged (Atkinson, 1999).

Another study shows that feedback in escalation situations can be positive, negative, or equivocal (Bowen, 1987). Often the idea that the course of action is failing is founded in the idea of negative feedback. Escalation is seen as occurring in part due to the equivocal nature of feedback. Bowen reasons that feedback must be perceived as negative enough to force action; that much feedback can be perceived as more or less negative depending on, among other things, its context. If the equivocality of the information being used is mapped onto a spectrum that ranges from clearly negative, through equivocal, to clearly positive, movement along the spectrum from an equivocal decision context to an unequivocal decision context could be accomplished by collecting additional data.

The idea that the structure of project management practice and information can influence decision makers’ tendency to continue a project is not a new one (Sabherwal et al., 2003). Gross measures such as size of payoff for the project and cost of payoff were found to be moderately correlated with a decision to continue the project (Sabherwal et al., 2003). This represents another indication that there is more data involved than the large scale standard project management measures.

Abandonment/Cancellation

Abandonment literature has focused on the degree of abandonment (Ewusi-Mensah and Przasnyski, 1991) and the organizational factors leading to abandonment (Oz and Sosik, 2000). It has been found that some degree of abandonment may occur due to redirection of the project and that total abandonment may occur due to organizational issues or issues outside of management’s control, such as a change in environment (Ewusi-Mensah and Przasnyski, 1991).

Noticeably absent from all of the research streams is the exploration of the actual information that is absent in the case of poor project continuation decisions when compared to good project continuation decisions.

RESEARCH MODEL

In order to find what information is missing in the decision equation, it is necessary to understand what decision is being made. In the case of project management continuation decisions, it is whether to continue work on the project, in either the current or a modified form, or to stop work and redirect the resources elsewhere.

In order to find the additional information that improves decision quality, it will be useful to study continuation decisions that, in retrospect, turned out to be incorrect decisions and compare them to continuation decisions that, in retrospect, turned out to be correct decisions. Comparing the actual decision made against the retrospectively correct decision then provides a two-by-two matrix into which projects can be classified based on the decisions made (see figure 1).
The resulting classification of a decision, based on the actual decision made and the retrospectively correct decision, into the quadrants then proceeds as follows:

Quadrant 1 – A continue decision was made and retrospectively the decision should have been to continue. This is a correct decision and results in proper continuation of the project.

Quadrant 2 - A stop decision was made and retrospectively the decision should have been to continue. This is an incorrect decision and results in abandonment of the project without good cause.

Quadrant 3 - A continue decision was made and retrospectively the decision should have been to stop. This is an incorrect decision and results in escalation of the project without good cause.

Quadrant 4 – A stop decision was made and retrospectively the decision should have been to stop. This is a correct decision and results in proper cancellation of the project.

Overlaying these definitions into the quadrants, the following diagram is derived:
Bowen (1987) finds that the information in continuation decisions falls into three categories: clearly negative, clearly positive, and equivocal. Equivocal feedback is defined as feedback that reasonably supports both positive and negative interpretations; the definition also implicitly includes feedback that is neither clearly positive nor clearly negative. Placing these three categories on a continuum from positive feedback, through equivocal, to negative feedback provides an informative view when compared to the decision that retrospectively should have resulted from it. In the case of clearly positive overall feedback concerning a project, the obvious decision would be to continue the project. Conversely, when the overall feedback is clearly negative, the project should be stopped or redirected. The area between these two extremes, where the overall feedback is equivocal offers the greatest opportunity for poor decisions. This can be shown graphically by adding the retrospective view of the feedback figure 2 above (see figure 3). Equivocal indications fall on both sides of the “should have” continued / “should have” stopped line showing that equivocal feedback is insufficient, by itself, to make the proper decision, in agreement with Bowen.

![Figure 3](image.png)

This results in a framework for classification of actual decisions under conditions of equivocal feedback according to the retrospective quality of those decisions.

**IMPLICATIONS**

The framework highlights comparisons that will allow an empirical study of the data available and used in continuation decisions under conditions of equivocal continuation feedback. These comparisons will go beyond a simple comparison between continuation feedback that is clearly positive and continuation feedback that is clearly negative. Classification according to this framework will provide a rich set of comparisons that will allow us to more clearly understand the information set that practitioners actually use in these decisions.

For example: the equivocal area within the continuation quadrant represents a good decision made with equivocal feedback, while the remaining area within the continuation quadrant represents a good decision made with clearly positive feedback. Finding otherwise similar projects that are classified on either side of this boundary and comparing the data available when the decision was made will allow us to understand better what constitutes equivocal feedback that is understood to be positive enough to result in a decision to continue the project.

Another example: the equivocal area within the cancellation quadrant represents a good decision made with equivocal feedback, while the equivocal area within the abandonment quadrant represents a bad decision made with equivocal feedback. A comparison of the decisions in these two classifications will aid in our understanding of seemingly small indications that may be considered equivocal by themselves, but support conflicting decisions.
One of the ways Bowen (1987) suggests to clarify equivocal feedback is to find more data. As this model will allow comparison of good and bad decisions under conditions of equivocal and non-equivocal feedback, it will result in additional data from the analysis of previous decisions. This leads to the following research proposition to be explored:

Research Proposition: Examination of data sets used in making project continuation decisions under conditions of equivocal feedback combined with the decision result (continued, abandoned, escalated, or cancelled) will reveal additional data not found in the principal information set of schedule conformance, budget conformance, and quality of the results.

While an analysis of all four quadrants is necessary to clarify decision information, the goal is to reduce “bad” decisions. Thus, the focus will be on abandonment and escalation decisions. We propose that identifying ways to reduce the size of the equivocal information band for a continue/stop decision will result in more effective decisions – that is, a reduction in the occurrence of escalated projects and projects that are abandoned prematurely.

CONCLUSION

The framework developed in this study should have practical application as we continue the search for more definitive and actionable information to support project continuation decisions. Comparisons of continue/stop decisions made under conditions of equivocal information that were retrospectively determined to be correct or incorrect should highlight the subtle cues that allow failing projects to be cancelled early, or escalating projects to be redirected.

Additional avenues of research are also available under this framework. The quality of the standards used in making project decision may also play a considerable part in what makes information appear equivocal. Additional research in this area may provide another means of shrinking the equivocal band and producing better decisions and outcomes.

REFERENCES

OPEN SOURCE BACKLASH: SOFTWARE USAGE IN A MANDATORY CONTEXT

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ABSTRACT
When management mandates the use of a particular technology, that decision may be met with resistance. Potential resistance may be mitigated by both understanding the process of change (e.g., Cotter, 1996; Lewin, 1951) as well as better managing changes through tactics such as enlisting support from top management, gaining greater stakeholder involvement, and establishing stern consequences for non-compliance. Despite these efforts, wholehearted acceptance of a mandated technology by management may never be realized. The objective of this research-in-progress is to examine whether mandates evolve over time and posit the factors that influence mandates as a way to identify additional means to address potential resistance. Evidence of possible influences is identified through interview results from Thailand and plans for future research are discussed.

Keywords
Technology acceptance, mandatory technology use, open source technology

INTRODUCTION
Organizations mandate the behavior of their employees for a variety of reasons. In light of the recent economic downturn in combination with a much stronger enforcement of software copyright violations, many Thai organizations from both the public and private sector have mandated the use of open source software. One public Thai organization that has mandated the use of open source software since 2007 has been held up as an exemplar for other firms to follow. This organization employed several tactics to facilitate the change towards this mandate, such as holding multiple training sessions and establishing both incentives and consequences for employees, to reach a usage rate of 100%. Despite this apparent success, full compliance of this mandate by employees has not been reached. This non-compliance is even more striking since Thais generally demonstrate deference towards power relationships and accept power inequalities as part of their cultural heritage (Hofstede 2004).

Much is still unknown about whether or to what extent mandates are negotiable (Chae and Poole, 2005). Previous studies in information technology acceptance research have developed several theories explaining an individual’s intention and behavior to use a particular technology. Venkatesh et al. (2003) integrated previous concepts and findings to formulate the Unified Theory of Acceptance and Use of Technology (UTAUT) to better explain volitional information technology use. This and many other information technology acceptance research (e.g., Hartwick and Barki, 1994; Karahanna et al., 1999; Moore and Benbasat, 1991) examine mandatory use on a continuum, which has the effect of treating it as a binary construct (Wu and Lederer, 2009).

The objective of this research-in-progress is to examine the complex nature of mandates, posit their likely influences, and present a case for how they may change over time. This research will provide the framework for a large-scale study of the mandated use of technology. A literature review is provided which further describes the research that has examined mandatory technology usage and also identifies the technology of interest to be examined, open source software. The methodology employed to examine the mandate of open source software is discussed as well as the tentative results. The future directions for this research are discussed, followed by some concluding remarks.
LITERATURE REVIEW

Technology Mandates

Information technology acceptance research (e.g., Hartwick and Barki, 1994; Karahanna et al., 1999; Moore and Benbasat, 1991; Venkatesh, 2003) often examines mandatory use on a continuum, which has the effect of treating it as a binary construct (Wu and Lederer, 2009). This is consistent with research that defines mandates by their consequences, which most often involve the choice of either following the mandate or leave the organization (Leonard-Barton, 1988). For employees that do value their jobs, the options that they have available to them are to not fully utilize the mandate, work to delay or obstruct its implementation, or even sabotage the effort (Markus, 1983; Kimberly, 1987; Leonard-Barton, 1988). As this type of research implies, mandates are much more complex and cannot be adequately captured as a binary construct. Further, the dependent variable of interest may not be the typical construct from the technology acceptance research that examines an individual’s intention to use the technology, but may be best captured instead an individual’s overall job satisfaction.

Brown et al. (2002) suggest that mandates and driven not only by managerial imperative, but from the organization’s very structure and culture. Interpretation is strongly tied to an organization’s norms, resources, and power structures (Giddens, 1984). Consequently, the interpretation of mandates is political by nature and its effectiveness depends on how the mandate impacts resource allocations and fits with existing organizational norms and behaviors (Chae and Poole, 2005). The implementation of a mandate may be rife with potential disagreements over how the mandate is carried out. Therefore, a problem solving process may result leading to consensus over the interpretation of the mandate or possibly disagreements in which different parts of an organization may interpret and act on the mandate differently (Chae and Poole, 2005). The resulting process that takes place once the mandate has been issued, both the formal and informal processes, is what this research examines.

Mandatory Technology Usage Influences

There are many factors that influence the decision to follow a mandate. The nature of the mandated technology itself will likely impact how an organization may interpret and act on the mandate. For example, some technology dimensions include how necessary the technology is to complete one’s job as well as the interdependence of technology use, that is, whether non-use of organizational spanning systems (i.e., ERP) negatively impacts the technologies effectiveness for other users (Brown et al., 2002). Ciganek and Wills (2008) suggested additional dimensions of technology, such as the degree of newness and the degree of change, to be considered as individual employees are likely to interpret the technology differently.

In addition to these technology dimensions, organizational culture will also likely have a strong influence in how a mandated technology is received by an organization. Organizational culture is the set of shared assumptions, values, and behaviors that distinguishes one group, organization, or nation from another (Hofstede 2004). Depending on how well-suited an organizational culture is for a particular mandate, it will likely motivate an employee to pursue either formal or informal processes in reaction that mandate. Finally, organizational structure may also influence responses to technology mandates. Whether formal processes exist to manage organizational changes (e.g., clearly defined reporting structure, utilization of a formal change control system, etc.) and whether those processes are appropriately utilized will likely impact how employees follow those procedures or pursue informal processes to circumvent them in response to an organizational mandate. Each of these influences identified will help create a clearer picture of the complexity of technology mandates and the processes by which organizations interpret them. Organizations will likely strive for an appropriate balance among them through a process of negotiation in response to a technology mandate (see Figure 1).

![Figure 1: Balance Necessary to Achieve Job Satisfaction](image-url)
Open Source Software

Open source software is computer software for which the source code and certain other rights that are normally reserved for copyright holders are provided under a software license that meets the Open Source Definition or that is in the public domain ("Open Source Software", 2010). The open source software that is examined in this research is Open Office, a popular desktop application software. Open Office 1.0 was first released in 2002 and its current release is version 3.1. There were at least 100 million individual downloads of Open Office version 3.0 and later by late 2009, which is an indication of its popularity and broad acceptance. The Open Office software consists of a variety of software applications that are comparable to the commercially available Microsoft Office. Microsoft Office applications are utilized by most organizations in nearly every country and are the industry standard desktop application. With respect to cross-technology compatibility between this software, users of Open Office can save work performed in Microsoft Office format. However, it is better save work in its own native Open Office format because users might lose some information if work is saved in a non-native format.

RESEARCH METHODOLOGY

In this study, we examined a public Thai organization that had implemented a mandate for its employees to utilize open source software over commercially available software. This organization was examined through observation and interviews over a two week period in 2009. Current and former employees were purposely selected to be interviewed because they were secretly using licensed software to perform their assigned work even after the mandatory use technology policy was in effect. Interviews were conducted in two separate sessions and lasted for an average of thirty minutes. The first session was a face-to-face interview while the second session was done using a telephone to clarify the information provided in the first session and to follow-up with further questions to receive additional information.

Organization Background

The Thai organization was established in 1986. The Thai organization consists of thirty-one functional departments that have responsibility to develop and research information technology before transferring that knowledge and experience to other public and private organizations. The majority of employees of this organization are very technical oriented and relatively young. In 2007, the Thai organization set out to be an exemplar corporation of its implementation of open source software, seeking to transfer its own experiences and knowledge of the process to other firms. The open source technology mandated use policy was utilized as a key factor to influence employee usage. In addition, several training sessions for all employees were carried out by the Thai organization. Other organizational resources, facilities, and tactics were utilized to support the usage of open source software, such as providing top management support and employing a knowledge management system.

TENTATIVE INTERVIEW RESULTS

During initial observations, the technology mandate appeared to be a success as employees were utilizing the open source software. The most popular applications used within the organization were email, web browser, document, and spreadsheet applications. Symptoms of problems began to emerge after the mandate was implemented. There was low user satisfaction in some departments and requests from departments to continue using commercial software. A relatively small department within the organization requested a budget to purchase a commercial software license because many of its employees frequently communicated with individuals external to the firm that were using that commercial software. In addition, many employees covertly utilized their personally-obtained commercial software to perform their daily work, choosing then to convert those files into the open source format before submitting them. The departments that were successful in their requests to continue using commercial software were unique from other departments within the organization. These successful departments were required to have employees that exchanged files with external organizations, while those departments that were not allowed to use commercial software mostly communicated within the organization (see Figure 2).

Figure 2: Graphical Depiction of Department Commercial Software Utilization
The Thai employees that were interviewed both complained about the inconvenience of exchanging the open source documents and spreadsheet files for their personal use, but were satisfied with the open source training they received and the support that was given from their managers. When an employee wanted to send a file for their own personal use, they often forgot to convert their file into the appropriate format. This resulted in an inconvenience for the employee and an inefficient use of time.

Although the Thai employees knew how to configure the open source applications to save their work in a particular format, they were not allowed because of the organizational mandate to exchange files using the open source format at work. From the interviews, it could not be determined whether departments that had the most connections with other internal departments would not have employees secretly using their own commercially licensed software. These interviews did reveal that the Thai employees would exchange more files for personal usage than exchange files to be submitted to their superiors. Further, there were employees in almost every department that at least once secretly used their own commercially licensed software to perform their assigned tasks. Through additional examination, we discovered that employees that secretly use the commercially licensed software often exchange file documents through social exchanges of files with friends external to the organization. These Thai employees complained that they were not very confident that the open source files would format perfectly with their counterparts that used the commercially licensed software. Thai employees often had to send multiple e-mails, having to re-format the file into the commercially licensed software because they had mistakenly sent e-mails with files in the open source format.

DISCUSSION

These interviews with Thai employees illustrate an instance where the mandated use of open source technology evolves and may continue to evolve through a series of internal negotiations. It is clear that in this situation, an organizational mandate is hardly a binary construct but an ongoing process involving politics, culture, and technology. This is similar to the findings of Chae and Poole (2005) which examined two separate mandates for enterprise system usage and found that as the development and implementation of these enterprise systems proceeded, adopters whose political or financial interests were threatened by the new systems began to search for ‘cracks’ in the mandate and began to try out strategies for resisting or redefining them. This negotiation process by the employees of the Thai organization in an attempt to redefine the open source mandate is somewhat surprising since Thais generally demonstrate deference towards power relationships and accept power inequalities as part of their cultural heritage (Hofstede 2004).

There are several avenues for future research to follow. First is to identify an appropriate research model to examine the potentially complex nature of technology mandates. Mandates may not be best categorized by a simple ‘yes’ or ‘no’ dichotomy but rather may be best observed over time examining the multiple influences on these organizational edicts. These influences that we intend to examine include both institutional features (i.e., organizational culture and structure) as well as facets of the mandated technology itself, such as how necessary the technology is to complete a task, its interdependence, and how radical the technology is. Future research must also participate in the ongoing debate of the appropriate dependent variable as satisfaction and motivation may be more suitable than behavioral intention to use open source technology. As indicated in the Thai interviews, a lack of satisfaction with open source technology was a key driver in the pursuit of negotiating the terms and the noncompliance with the organizational mandate. It appears to suggest that satisfaction and motivation with the mandated technology may far outweigh the behavioral intention to use that mandated technology (Brown et al., 2002; Chae and Poole, 2005). With respect to this research, however, the construct of job satisfaction might be more relevant to examine than the satisfaction with the technology itself. This is consistent with research that defines mandates by their consequences, which most often involve the choice of either following the mandate or leave the organization (Leonard-Barton, 1988).

CONCLUSION

When management mandates the use of a particular technology, that decision may be met with resistance. The majority of previous research that has examined the acceptance of mandated technologies has perhaps overlooked the complexity of an organizational mandate by capturing it as a binary construct. We believe that a mandate to use a technology will involve a process of negotiation over a period of time that has many influences. As a result, a mandate may either reinforce an organization’s culture and formal structure or produce informal processes to address mismatches in the culture, structure, and technology. The objective of this research-in-progress is to examine whether mandates evolve over time and posit those factors that influence mandates as a way to identify additional means to address potential resistance. Evidence of possible influences was identified through interview results from Thailand and plans for future research were discussed.
REFERENCES


UNDERSTANDING THE IMPACT OF TRANSACTIVE MEMORY SYSTEMS ON PROJECT TEAM PERFORMANCE: THE MEDIATING ROLE OF KNOWLEDGE INTEGRATION AND COLLECTIVE MIND

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ABSTRACT
This study aims at exploring potential mediators between transactive memory systems (TMS) and team performance. We argue that TMS facilitates knowledge integration and the forming of collective mind, which in turn, affect team performance. Collecting data from 205 project managers in Taiwan supports our hypotheses that knowledge integration and collective mind serve as mediator between TMS and team performance.

Keywords
Transactive memory systems, collective mind, knowledge integration, ISD team

INTRODUCTION
Information system development is a knowledge intensive work and the lack of knowledge or competence erodes the performance of ISD project (Gemino, Reich and Sauer 2007). Because of the high complex nature, team-based work style is adopted by organizations to increase the availability of knowledge. However, successful ISD does not only count on the existence of required knowledge but also the capability of blending them together (Faraj and Sproull 2001; Mitchell and Nicholas 2006). Effective problem solving requires members to synthesize their knowledge as well as align their actions.

Transactive memory system, i.e. knowing the location of knowledge and the way to access it, was recognized to have positive impact on teamwork. Most past researchers have focused on its impact on team performance directly and ignored that teamwork process influences the effect of TMS to final teamwork outcome. To advance our understanding about the role and impact of TMS within an ISD team, there is a need to explore its impact on teamwork process.

The purpose of this study is to understand how TMS impacts team performance via teamwork processes: knowledge integration and collective mind. The rest of this paper is organized as follows. In the second section, we first review past studies on knowledge integration, transactive memory system, and collective mind. Hypotheses are then developed. In the fourth section, method to examine proposed model is introduced. Research results and implications are followed by conclusion.

LITERATURE REVIEW
Transactive Memory Systems
Transactive memory system describes the active use of transactive memory by two or more people to cooperatively store, retrieve, and communicate information (Lewis 2003). In a team, TMS is a collective system for encoding, storing, and retrieving information that is distributed across members (Wegner 1995; Wegner, Giuliano and Hertel 1985). It can be viewed as a set of knowledge possessed by group members, coupled with an awareness of understanding of each other’s knowledge. It is broadly accepted that TMS is critical for effective teamwork process and performance. TMS affects knowledge management within the team through three processes. First, the directory updating function allows group members to be aware of the location of special knowledge possessed by specific individual. Second, information allocation function represents the process of distributing knowledge to the members whose expertise is best suited for its storage. Third,
the retrieval coordination function shows how to retrieve needed information on any topics based on related knowledge from individual expertise in the memory system (Wegner 1995).

**Knowledge Integration**

Knowledge integration can be defined as the synthesis of individual team members’ information and expertise through “social interactions” (Robert, Dennis and Ahuja 2008). Integration is not simply putting discrete pieces of knowledge together but, instead, teamwork processes are required to synthesize the knowledge held by different stakeholders and to create new knowledge or insight (Newell, Tansley, Huang, Surrey, Campus and Street 2004). In the information system development context, researchers referred integration to the process of coordinating specially expertise held by individuals or meld individually held information and know-how into a common stock of knowledge to solve problem and accomplish task in the project level (Mitchell and Nicholas 2006; Tiwana and McLean 2005). Knowledge integration is particularly important in highly interdependent tasks, e.g. ISD teamwork process. The effectiveness of system development is determined by team’s ability in importing external knowledge and ability in synthesizing internal knowledge (Mitchell and Nicholas 2006).

**Collective Mind**

Collective mind is defined as “a pattern of heedful interrelations of actions in a social system” (Weick and Roberts 1993). It is different from TMS in the way that TMS indicates the knowledge of who knows what, that is the interconnection of different team members’ knowledge, whereas collective mind implies the interconnection of the activities or actions of each team members (Akgün, Byrne, Keskin and Lynn 2006). With a collective mind, people in the same unit pay mindful attention to individual’s contributing, representing, and subordinating behaviors which generate consequence to the system level. In the ISD context, each of these three components can be represented by team member’s contribution to the project outcome, building internal model of the group, and putting team’s goals ahead of individuals’ goals.

![Figure 1 Research Model](image)

**Hypotheses**

Knowledge integration can be viewed as a process of blending knowledge from various sources to form new knowledge. Experiment-based studies pointed out that TMS impacts team performance by increasing information search capability, enhancing learning, and promoting communication among team members (Lewis, Lange and Gillis 2005; Rau 2006). TMS contributes to knowledge integration from two dimensions. First, it reduces the effort required for knowledge exchange and transfer by creating the knowledge map within the team. TMS also contributes to greater team efficiency because members are able to anticipate each other’s behavior by comprehending the knowledge and expertise possessed by each individual. Second, collective task or problem solving requires complementary knowledge possessed by different members. TMS, similar to a list of who knows what, enhances team’s ability in bringing greater amount of knowledge into group level to bear on ISD tasks. Therefore, the effect of knowledge integration is constrained by the maturity of transactive memory within the team (Alavi and Tiwana 2002). Based on the above literature, we hypothesize that
H1: TMS has a positive effect on knowledge integration

The accomplishment of ISD is based on specialized knowledge possessed by team members as well as team’s capability to integrate those diversified knowledge effectively. The integration process allows members to access, explore, and use information from different knowledge domains related to the project. In addition, a comprehensive understanding toward problems and different alternatives can be generated to solve problems. Therefore, team performance can be enhanced through the integration of knowledge. Team level empirical studies also conclude that knowledge integration within teams can reduce software defects (Tiwana 2004), increase creativity (Tiwana and McLean 2005) and improve the performance of product innovation teams (Lin and Chen 2006). Hence, we hypothesize that

H2: Knowledge integration has a positive effect on team performance

Collective mind is found in the heedful interrelation of group members (Akgün et al. 2006; Cross 2000). A collective mind allows team members to act as one unit by meshing self-consciousness and mental models of team members. A collective mind doesn’t emerge automatically after including members in the ISD team. Some managerial interventions or team building activities are required. Researchers argued that TMS is one of the critical antecedents of collective mind. Two studies proposed a causal relationship between collective mind and TMS (Kanungo 2004; Yoo and Kanawattanachai 2001). Therefore, we hypothesize that

H3: TMS has a positive effect on collective mind

Collective mind is critical for the ISD teamwork because, with a collective mind, team members make their contributions to the joint outcome with attention and care, they have a global perspective of each other’s tasks and responsibilities, and individuals carefully interrelate actions to each other to maximize joint performance. The recent studies on collective mind, for example Crowston and Kammereer (1998), noted that collective mind helps team members become more coordinated. Although, in an ISD project, actions such as analysis, programming, and testing are conducted by individuals, the results need to be integrated to form the final system. Team can work in a high quality manner when members have consensus on each other’s role and responsibility. Moreover, Akgün et al. (2006) also found that collective mind improves team performance. Therefore, we hypothesize that

H4: Collective mind has a positive effect on team performance

The complex and rapid changing nature of ISD projects hint that teams are required to respond to environment in a timely and well coordinated manner. Initially, members of one team see problems from their own perspective and analyze possible causes based on their own expertise. During the knowledge integration process, members exchange knowledge or opinions to form new knowledge or comprehend each other’s viewpoint. After integrating knowledge from individuals, members’ understanding toward problems or tasks is not limited to individual level anymore. They can see problem from a higher level and see how different members should cooperate with each other in order to deal with problem efficiency and effectively. Therefore, we argue that with effective knowledge integration, members can form a collective mind easier.

H5: Knowledge integration has a positive effect on collective mind

RESEARCH METHOD

A survey research was conducted to examine proposed hypotheses. Project managers were selected to complete the survey because managers have a comprehensive view of the teamwork process and outcome evaluation (Zimmer, Henry and Butler 2007). A total of 205 surveys were returned. Table 4 shows the characteristics of our respondents. Among those respondents, 62% of them are male; over 92% of them has college or higher degree, about 60% of them has less than 10 years work experience.

Constructs

A total of 15 items obtained from Lewis (2003) were used to measure the specialization, credibility, and coordination of TMS within the team. A total of 4 items obtained from Tiwana and McLean (2005) were used to measure knowledge integration within the team. A total of 4 items obtained from Weick and Roberts (1993) were used to measure the extent to which individuals in the same team heedfully interrelate their actions. Project performance was measured using seven items adopted from existing scales (Henderson and Soonchul 1992) All above items were measured on a 5-point Likert scale, with anchors ranging from 1 (strongly disagree) to 5 (strongly agree).

Item reliability, convergent validity, and discriminant validity tests are often used to evaluate the measurement model in PLS. As indicated in table 1 and table 2, the composite reliability, Cronbach’s alpha, averaged variance extracted (AVE), correlation matrix, and factor loadings indicate that all requirements are assured.
### Table 1. The Results of Factor Analysis

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<td>.745</td>
<td>.603</td>
<td>Knowledge Integration</td>
<td>KI1</td>
<td>.831</td>
</tr>
<tr>
<td>TMS-S4</td>
<td>.757</td>
<td>.606</td>
<td>CR=0.903</td>
<td>KI2</td>
<td>.858</td>
</tr>
<tr>
<td>TMS-S5</td>
<td>.760</td>
<td>.542</td>
<td>Alpha=0.857</td>
<td>KI3</td>
<td>.811</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>AVE=0.699</td>
<td>KI4</td>
<td>.842</td>
</tr>
<tr>
<td>TMS-Credibility</td>
<td>TMS-CR1</td>
<td>.684</td>
<td>Team Performance</td>
<td>TP1</td>
<td>.816</td>
</tr>
<tr>
<td>CR=0.892</td>
<td></td>
<td></td>
<td>CR=0.919</td>
<td>TP2</td>
<td>.865</td>
</tr>
<tr>
<td>Alpha=0.849</td>
<td></td>
<td></td>
<td>Alpha=0.894</td>
<td>TP3</td>
<td>.812</td>
</tr>
<tr>
<td>AVE=0.625</td>
<td></td>
<td></td>
<td>AVE=0.654</td>
<td>TP4</td>
<td>.783</td>
</tr>
<tr>
<td>TMS-Coordination</td>
<td>TMS-CO1</td>
<td>.806</td>
<td>Collective Mind</td>
<td>CM1</td>
<td>.843</td>
</tr>
<tr>
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<td></td>
<td>CR=0.901</td>
<td>CM2</td>
<td>.828</td>
</tr>
<tr>
<td>Alpha=0.773</td>
<td></td>
<td></td>
<td>Alpha=0.854</td>
<td>CM3</td>
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<td>AVE=0.686</td>
<td></td>
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<td>AVE=0.694</td>
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<tr>
<td>TMS</td>
<td>TMS-Specialty</td>
<td>.652</td>
<td></td>
<td></td>
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<tr>
<td>2^nd Order</td>
<td>TMS-Credibility</td>
<td>.855</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TMS-Coordination</td>
<td>.780</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**M3: Skewness; M4: Kurtosis**

**The diagonal line of correlation matrix represents the square root of AVE**

### Table 2. Descriptive statistics and correlation matrix

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>M3</th>
<th>M4</th>
<th>Correlation Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TMS</td>
</tr>
<tr>
<td>TMS</td>
<td>3.80</td>
<td>0.41</td>
<td>0.00</td>
<td>0.60</td>
<td>0.77</td>
</tr>
<tr>
<td>Knowledge Integration</td>
<td>3.73</td>
<td>0.55</td>
<td>-0.39</td>
<td>1.15</td>
<td>0.59</td>
</tr>
<tr>
<td>Team Performance</td>
<td>3.68</td>
<td>0.54</td>
<td>-0.23</td>
<td>1.24</td>
<td>0.51</td>
</tr>
<tr>
<td>Collective Mind</td>
<td>3.57</td>
<td>0.64</td>
<td>-0.65</td>
<td>1.41</td>
<td>0.66</td>
</tr>
</tbody>
</table>

**The diagonal line of correlation matrix represents the square root of AVE**
DATA ANALYSIS & RESULTS
Hypothesis testing was conducted through partial least squares regression analyses using PLS Graph 3.0. As indicated in Figure 2, all hypotheses are supported.

![Figure 2 Results of the Mediated Model]

Notes: The significance of the path estimates was calculated using a bootstrap technique with 500 resamples. * p<0.05, ** p<0.01, *** p<0.001, (one-tailed)

CONCLUSION
The focus of this study is to examine the mediating role of knowledge integration and collective mind on team performance. Our survey of 205 ISD project managers confirmed all proposed hypotheses. Higher level of TMS within the team improves knowledge integration and collective mind, which in turn, lead to better performance. We add another perspective in understanding the role of TMS – it generates impact on team performance through facilitation of some teamwork processes, such as knowledge integration and collective mind.

Since the critical role of TMS has been identified, the formation of TMS within ISD team is determined as an important issue. Different approaches can be applied to foster TMS within the team in different teamwork dimensions. First, in the initial formation stage, training together provides a mean for members to develop TMS. Second, during the team work, task interdependence generates the need for interaction among members. Project managers or team leaders can incorporate interdependence into task design. Third, TMS can also be formed through informal communications during informal circumstances, such as parties. Informal communication without pressure allows members to build close relations which is one important antecedent of trust. Project managers or team leaders can nurture TMS within the team through these approaches. With a mature TMS, the team can integrate knowledge possessed by individuals to counter problems in task level and, then, improve teamwork performance.

REFERENCES
KM Capability Assessment: A Qualitative Approach

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ABSTRACT

The knowledge management (KM) literature highlights both the desire of organizations to assess KM capability and the need to create better methodologies and tools to do so. Although some progress has been made in developing valid assessment tools, the topic still remains inadequately explored. Answering a call for the exploration of KM capability maturity assessment across a variety of organizations (Kulkarni & St Louis, 2003), this research uses the Knowledge Management Capability Assessment (KMCA) methodology (Kulkarni & Freeze, 2004) and Freeze & Kulkarni (2005; 2006) as a guiding framework to qualitatively assess the KM capability of the Secretary of the Air Force Financial Management and Comptroller (SAF/FM) organization—a military organization recognized for exceptional KM efforts. The research resulted in rich, contextual findings with regard to the specific KM efforts underway within SAF/FM. Interestingly, the nature of these efforts translated into KM capability levels lower than expected; however, precise areas for improvement were identified.

Keywords  
Knowledge management (KM), KM maturity, KM capability, KM assessment, KM capability maturity, case study

INTRODUCTION

The US military services have increasingly recognized the importance of knowledge as a critical resource. As such, each of the military services have put into place KM programs to varying degrees. Although the implementation of KM in the Air Force has been progressing at an overall slow pace (Bartczak, 2002; Sasser, 2004), one organization, Secretary of the Air Force Financial Management and Comptroller (SAF/FM), is continually recognized as a leader in KM. SAF/FM finds it difficult, however, to assess the maturity and effectiveness of its KM efforts. Answering the call by Kulkarni & St. Louis (2003), Freeze & Kulkarni (2004), Berztiss (2002), and others to explore KM assessment across a variety of organizations, this research explored the topic in a military (AF) organization context. By turning, specifically, to the KM maturity assessment work by Kulkarni & St Louis (2003) and the KM capabilities assessment (KMCA) work by Kulkarni & Freeze (2004) & Freeze & Kulkarni (2005; 2006), the objective of the larger research effort was to provide a KM capabilities assessment for a presumably KM-mature organization, albeit using a qualitative application of the KMCA instrument. This paper highlights the findings as guided by the following research questions:  
#1--How does a presumably KM-mature organization operationalize its KM efforts?  
#2--How do the results from research question #1 translate into KM capability levels?

LITERATURE REVIEW

As a critical resource, knowledge demands good management (Holsapple & Joshi, 2001). “Measurement of organizational knowledge assets and their associated knowledge processes is necessary to determine the effectiveness of knowledge management initiatives” (Freeze & Kulkarni, 2005, pg. 1). By assessing the knowledge capabilities of the organization and by advancing to higher maturity levels, an organization can fulfill its purposes much more efficiently (Berztiss, 2002). Several practitioners and academics have attempted to translate KM capability maturity using the well-established Capability Maturity Model for software as a foundation (Berztiss, 2002; Harigopal, 2001; Ehms & Langen, 2002; Hung & Chou, 2005). These KM maturity models, however, while contributing knowledge towards a practical maturity model for KM, have lacked real-world application (Kulkarni & St. Louis, 2003). More specifically, the models have lacked detailed description, operational classification of different types of knowledge, and definitions of levels in terms of goals and validation (Kulkarni & St. Louis, 2003; Kulkarni & Freeze, 2004 & 2006). Additional models, based on empirical data, for measuring the KM capability of an organization include those by Gold, Malhotra, & Segars (2001), Freeze & Kulkarni (2005), and Kulkarni & Freeze (2006). Unlike Gold et al. (2001) who defined a
KM capability framework comprised of two constructs—knowledge infrastructure capability and knowledge process capability—Kulkarni & Freeze (2004) and Freeze & Kulkarni (2005; 2006) present a framework that focuses on the distinct specialization of the knowledge life cycle across knowledge themes while viewing technology and culture as embedded enablers of the knowledge processes. Specifically, the Kulkarni and Freeze knowledge management capability assessment (KMCA) allows the ability to identify “separate knowledge capabilities that may be individually measured and leveraged within a single organization to more effectively meet...objectives” (Freeze & Kulkarni, 2005, pg. 1).

Knowledge Management Capability Assessment
The Knowledge Management Capabilities Assessment (KMCA), developed over time by Kulkarni and St. Louis (2003) and Kulkarni & Freeze (2004) and Freeze & Kulkarni (2005; 2006), provides a methodology and a validated, empirically-tested survey instrument for organizational self-assessment of KM capability. The survey instrument consists of 128 scale items grouped by four knowledge themes and knowledge-sharing culture (the latter is not addressed in this paper due to space). Each knowledge theme (expertise, lessons learned, knowledge documents, and data) also has a distinct representation of the various processes of the knowledge life cycle which includes acquire, store, present, and apply. Each of the survey instrument questions corresponds to a capability level for a specific knowledge theme/knowledge life cycle process. The capability levels and associated general goals for each level of the KMCA are listed below in Table 1. Table 2 shows a summary of the knowledge processes as they intersect with the knowledge themes (accompanied by examples of technology enablement).

<table>
<thead>
<tr>
<th>Capability Level</th>
<th>Behavior Goals</th>
<th>Infrastructure Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 1:</strong> Possible</td>
<td>- Knowledge sharing is not discouraged</td>
<td>- Knowledge assets are recognized/identified</td>
</tr>
<tr>
<td>Level 2: Encouraged</td>
<td>- Organization’s culture encourages/rewards all activities w/respect to sharing of knowledge assets</td>
<td>- Explicit knowledge assets are stored in some fashion</td>
</tr>
<tr>
<td></td>
<td>- Ldshrpp communicates commitment to knowledge sharing</td>
<td>- Tacit and implicit knowledge is tracked</td>
</tr>
<tr>
<td>Level 3: Enabled/Practiced</td>
<td>- Sharing of knowledge assets is practiced</td>
<td>- KM systems/tools and mechanisms enable activities with respect to knowledge sharing</td>
</tr>
<tr>
<td></td>
<td>- Leadership/senior management sets goals with respect to knowledge sharing</td>
<td>- Repositories/knowledge taxonomies exist</td>
</tr>
<tr>
<td></td>
<td>- KM related activities are a part of normal workflow</td>
<td></td>
</tr>
<tr>
<td>Level 4: Managed</td>
<td>- Employees find it easy to share knowledge assets</td>
<td>- Training/instruction/tools available for KM system usage</td>
</tr>
<tr>
<td></td>
<td>- Knowledge sharing is formally/informally monitored/measured</td>
<td>- Change management principles are used to introduce KM practices</td>
</tr>
<tr>
<td>Level 5: Continuously Improved</td>
<td>- Mechanism and tools to leverage knowledge assets are widely accepted</td>
<td>- Business processes/tools/mechanisms that support sharing of knowledge assets are periodically reviewed/improved</td>
</tr>
<tr>
<td></td>
<td>- There is a systematic effort to measure and improve knowledge sharing</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. KM Capability Levels with Associated General Goals (adapted from Kulkarni & Freeze, 2004)

<table>
<thead>
<tr>
<th>Capability</th>
<th>Acquire</th>
<th>Knowledge Process</th>
<th>Apply</th>
<th>Technological Enabler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expertise</td>
<td>Registering and domain expertise</td>
<td>Corporate “directory” of expertise (“yellow pages”)</td>
<td>Multiple contact avenues along business needs for various expertise areas</td>
<td>Initiating contact, facilitations of knowledge exchange for issue resolution/learning</td>
</tr>
<tr>
<td>Lessons Learned</td>
<td>Periodic activities designed to capture relevant successful and failed experiences</td>
<td>Repository of internal best practices, solutions to known problems</td>
<td>Multiple avenues for access of relevant lessons</td>
<td>Reviewing of prior best practices or focused solving of a specific problem</td>
</tr>
<tr>
<td>Knowledge Documents</td>
<td>Accumulation from internal and external sources</td>
<td>Knowledge Bases of documents in text and rich format</td>
<td>Categorization schemes in order to support the workers mental models</td>
<td>Searching and retrieval of relevant documents</td>
</tr>
<tr>
<td>Data</td>
<td>Automated data accumulation into data warehouse</td>
<td>Aggregated data structures for quick retrieval in various DW cubes</td>
<td>Pre-calculated queries and accurate, timely and relevant DW reports, OLAP facility</td>
<td>Effective data-driven decision making support via analytical and graphical tools</td>
</tr>
</tbody>
</table>

Table 2. Summary of Knowledge Themes (Freeze & Kulkarni, 2006)
SAF/FM Knowledge Management Program

SAF/FM is an organization that provides financial guidance to Air Force decision makers as well as provides customer-focused financial services to the Air Force. In 2002, SAF/FM embarked on a KM initiative. The goal for the first phase of KM effort was to develop a KM system. Instead of developing a new system, the existing Air Force Knowledge Now (AFKN) portal was used (Laufersweiler & Sargent, 2003). The AFKN portal is a web-based KM system that centers around a community of practice (CoP) methodology which facilitates collaboration across a dispersed workforce. Thus, all CoP workspace features are geared towards enabling teamwork, communication, and sharing within a virtual environment (Laufersweiler & Sargent, 2003). Initially, the KM tools available on the AFKN portal included a powerful Verity® search engine, “Wisdom Exchange” for posting hints/advice/expertise, discussion forums, and a document management system to name a few. SAF/FM also hired a CKO to lead its KM initiatives and to cultivate a knowledge-sharing culture. At the time of this research, the focus of SAF/FM’s KM program was primarily on explicit knowledge capture and transfer via 330+ CoPs to the extent it could be facilitated by the AFKN KM system.

METHODOLOGY

In accordance with Yin (2003), this research used a single, explanatory case study design. A case study approach allowed a qualitative application of the KMCA where administering the KMCA survey instrument was deemed inappropriate due to sample size limitations. Data collection was accomplished using a variety of methods and sources to include documentation obtained from the SAF/FM KM system, researchers’ observations of the SAF/FM KM system website content/tools, and through in-depth interviews with nine, key SAF/FM knowledge workers. The final interview protocol consisted of 22 open-ended questions. It should be noted, however, that instead of directly translating interview questions from the KMCA survey instrument, the final interview questions were derived from the definitions and descriptions of the desired end-state conditions required for each knowledge theme (expertise, lessons learned, knowledge documents, and data) across each process of the knowledge life cycle (acquire, store, present, apply) as identified by Kulkarni & Freeze (2005; 2006) and Freeze & Kulkarni (2006). The qualitative version of the KMCA interview protocol was sent to Kulkarni & Freeze for comments, validation of content, and refinement prior to conducting the interviews. Analysis of the data obtained from the interviews and a review of KM system components, as well as, other KM-related documentation was accomplished using Yin’s (2003) pattern–matching procedures. Relative to research question #1, obtained data was matched against the associated activities and descriptions of the knowledge processes within each of the four knowledge themes (Table 2). Relative to research question #2, data identified as operational activities of SAF/FM’s KM program was matched against KMCA capability level goals (Table 1) for each knowledge theme. Requirements for scoring the capability levels of each knowledge theme was provided by Kulkarni and Freeze and are the same scoring criteria used for the KMCA survey instrument. (The full scoring legend for each knowledge theme was not included due to space limitations but can be provided upon request). Research design quality, construct validity, internal validity, external validity, and reliability were all addressed in accordance with Yin (2003).

RESULTS

Research question #1: How does a presumably-KM mature AF organization operationalize its KM efforts?

Knowledge Theme – Expertise

Acquire (Expertise)

The acquire process with regard to expertise is about documenting the domain (subject matter) expertise and contact information of experts into a standard profiling scheme (Freeze & Kulkarni, 2006). Respondents indicated that there was no formal mechanism in place to document or organize domain expertise; however, most of the respondents identified the main ‘Wisdom Exchange’ feature of the SAF/FM KM system or their localized version of ‘Wisdom Exchange’ (specific to a CoP) as a means of documenting expertise. An interview subject stated, "I mean, there's no real validation process, like I said I consider myself an expert in budget and policy, so I just went and signed up." Some knowledge worker respondents could not identify a process to identify expertise at all.

Store (Expertise)

The store process with regard to expertise may take the form of a “yellow pages” or a directory that stores contact and relevant subject matter expertise information (Freeze & Kulkarni, 2006). Respondents indicated that there was no central repository or directory of experts, however, such expertise was stored informally. Responses ranged from using the various CoPs as a directory of experts to using the traditional functional hierarchy of the organization as an indirect directory of experts. One interview subject stated, "you've got all the communities of practice there [in the SAF/FM KM system] listed categorically and that's really how you would get to domain expertise."
Present (Expertise)
The present process with regard to expertise is where the knowledge workers are able to identify the right experts for their knowledge needs as well as providing social interactions for experts to exchange tacit knowledge (Freeze & Kulkarni, 2006). The lack of a central repository or “yellow pages” of experts within the SAF/FM KM system corresponded with problems in the ability to search and find expertise. Such problems were evident in the various search methods identified by the knowledge workers.

Apply (Expertise)
The apply process with regard to expertise occurs through the social interaction of experts resulting in the resolution of the issue that prompted the interaction (Freeze & Kulkarni, 2006). Overall, responses indicated that interacting with other experts was done on an "as needed" basis but not always with the help of the KM system. One person stated, “I worked on the FM web-based training guides, so, [I consulted with SMEs] on a daily basis. I [received] help to get [the training guides] developed by SME support, but I developed my own SME list for our sub team.”

Knowledge Theme – Lessons Learned
Acquire (Lessons Learned)
The acquire process with regard to lessons learned deals with the ability of the organization to capture relevant successful and failed experiences (Freeze & Kulkarni, 2006). Respondents indicated a formal process was not in place to capture lessons learned. The KM system was used to capture lessons learned but with limited success; one interview subject stated, "We don't have something that says 'lessons learned' that you can click on. It's more done, I think, on an individual CoP basis."

Store (Lessons Learned)
The store process with regard to lessons learned is about making knowledge persistent throughout the organization and is usually found in the form of an electronic repository (Freeze & Kulkarni, 2006). The SAF/FM KM system does not have a main repository for storing lessons learned. Again, responses indicated that lessons learned are stored informally on shared drives within the organization and disparately throughout CoPs on the SAF/FM KM system. One interview subject mentioned, "We have a CoP of our own...we post things, tons of things there, including weekly activity reports...we might want to create a lesson learned folder."

Present (Lessons Learned)
The present process with regard to lessons learned is about making lessons learned available and accessible to the knowledge worker in the form needed (Freeze & Kulkarni, 2006). Without a main repository for lessons learned, the availability and accessibility of lessons learned within the SAF/FM KM program is hit or miss. The majority of the knowledge workers interviewed agreed that trying to find lessons learned is often difficult. One respondent stated, "You could go to the raw files, but they're poorly organized at this point...."

Apply (Lessons Learned)
The apply process with regard to lessons learned is about them being used for value-producing action (Freeze & Kulkarni, 2006). The interview questionnaire addressed this by having the interviewees "provide an example of how using lessons learned helped you complete an important task." Overall, the responses indicated that they were applying lessons learned when they could locate them to help them accomplish their tasks more efficiently.

Knowledge Theme – Data
Responses indicated that SAF/FM KM does not handle the responsibility of data management itself. As one interview respondent stated, "There's a very clear line drawn from the leadership in terms of where data lies. We should be linking to it and providing folks a means to find our data, but we're not storing it." All aspects of (fiscal) data management for SAF/FM are under the responsibility of the IT organization, SAF/XC, Warfighter Integration. SAF/FM senior leadership stated that the SAF/FM KM program does not address data management; therefore, this knowledge theme was not assessed.

Knowledge Theme – Knowledge Documents
Acquire (Knowledge Documents)
The acquisition process with regard to knowledge documents includes accumulating knowledge from multiple internal and external sources into a document repository (Freeze & Kulkarni, 2006). The responses indicated that knowledge documents are accumulated mainly through the discretionary posting of the members and knowledge owners of the CoPs. For example, one person remarked, "Every time we'd do a document that we thought could pertain or help someone throughout the FM community, we'd post it in the CoP and...and send the link out to the FM community."

Store (Knowledge Documents)
The storage process with regard to knowledge documents is realized through a knowledge document repository that is easily accessible (Freeze & Kulkarni, 2006). The SAF/FM KM system serves as the repository for the knowledge documents of the organization. Each FM CoP uses the document management system that allows for the storage of all file formats (documents, memos, reports, spreadsheets, presentations, HTML files, databases, graphics, etc.) Documents were also reported to be stored on organizational shared drives.

**Present (Knowledge Documents)**
The presentation process with regard to knowledge documents deals with having a broad set of categorization schemes in order to support the mental models necessary for the knowledge workers’ minds to efficiently locate the required information and knowledge (Freeze & Kulkarni, 2006). For SAF/FM the categorization of knowledge documents within the CoPs is the responsibility of the knowledge owner of the CoP--there is not a categorization scheme or taxonomy that spans the entire KM system and all CoPs. Consequently, each CoP’s categorization scheme may vary. The taxonomies within each of the CoPs reportedly helped the interview subjects find knowledge documents. For example, one person related he would search for knowledge documents in the same manner as searching for lessons learned, saying, "I would typically go look to see what type of CoPs are out there [on the SAF/FM KM system] ... and see what type of documents they have."

**Apply (Knowledge Documents)**
The application process with regard to knowledge documents requires the use of search tools to aid in the retrieval of relevant knowledge (Freeze & Kulkarni, 2006). The effectiveness of the application may be measured in terms of improved general understanding of problems and better problem resolution (Freeze & Kulkarni, 2006). All of the respondents stated that they used the various search capabilities of the SAF/FM KM system to locate documents. Although there were variances reported, a majority of the respondents stated they had some difficulty in locating relevant knowledge documents. One interview subject stated "... a lot of times [the search] will pull up more information than you really need and you have to keep doing searches until you [find] what you're looking for."

**Research question #2: How do the results from research question #1 translate into KM capability levels?**

**Assessment of Expertise Capability**
Domain expertise and contact information of experts are not formally captured within SAF/FM. The identification of experts relies on volunteers within the FM community posting their information on the ‘Wisdom Exchange’ tool and/or within individual CoPs. Respondents revealed they depend on experts but are limited to manually searching through CoPs and posted comments within ‘Wisdom Exchange’ to find them. When unsuccessful, they also depend upon their own contact lists and social networks to identify expertise. As such, the overall capability level for the knowledge theme, expertise, was assessed at a capability level 2 out of a possible 5.

**Assessment of Lessons Learned Capability**
Lessons learned are not formally captured within SAF/FM. This process is left to the discretion of the CoPs. Consequently, without a central repository, lessons learned are difficult to find within the KM system. However, it was apparent that documenting, storing, and applying lessons learned was important for the success of the organization. As such, the overall capability for the knowledge theme, lessons learned, was assessed at a capability level 2 out of a possible 5.

**Assessment of Knowledge Documents Capability**
Knowledge documents are actively used within the SAF/FM KM system. Repositories and categorization schemes are available throughout the FM CoPs. Although the categorization schemes are not standardized across CoPs, responses indicated that the taxonomies within the CoPs are adequate. The overall capability level for the knowledge theme, knowledge documents, was assessed at a capability level of 3 out of a possible 5.

**CONCLUSION**
The research revealed that a qualitative assessment of an organization’s KM capability using the KMCA framework is possible, as well as beneficial, when survey administration is not feasible. The qualitative nature of the research allowed the collection of rich, contextual data that gave substance to the various capability level assessments as well as provided an illumination of specific SAF/FM KM activities that comprise those levels. Specifically, the research revealed implications for both practice and theory. For practice, the use of the KMCA methodology to guide this case study provided rich feedback for SAF/FM with regard to current state of its KM program/efforts and directions for future action. The research revealed capability level scores of 2-3 out of 5 which indicated that while the SAF/FM KM program may be exemplary within the AF, it still has much room for improvement. Needed actions include developing a centralized, searchable expertise repository, examining the need for a KM system-wide taxonomy, improving document meta-tagging and search, formalizing the capture and storage of lessons learned, and exploring the inclusion of key FM data as an element of the KM system. SAF/FM must also capitalize on the pockets of the FM community that
have higher KM capability levels and work to replicate the expertise across the FM community. As for theory, the research indicated that, although originally designed for quantitative assessment, the KMCA also provides an excellent framework for qualitative KM capability assessments. The methodological approach used in this research indicates a potential for generalizing to similar organization contexts that do not support survey administration. In comparing the results of this research with those previously reported by Freeze and Kularni (2005, 2006), it was found that the framework consisting of knowledge themes/knowledge life cycle processes was robust and allowed for capture/identification of all SAF/FM KM program activities and subsequent capability assessment. One issue that should be noted, however, was that researchers experienced some difficulty interpreting the overall KMCA capability level (scores) in relation to a KM program that spans an enterprise-wide community. The results revealed that some groups within the larger SAF/FM community are utilizing the SAF/FM KM system to accomplish KM activities at higher capability levels than others. As a result, disparities across units may not be reflected in any overall capability level assessment for any of the knowledge themes. Given the desire of many organizations with active KM programs to assess or benchmark their KM capabilities and/or KM maturity while simultaneously identifying specific areas for improvement, this research is important in that it highlights an additional, theoretically sound approach to doing so.

REFERENCES
KNOWLEDGE-RELATED BARRIERS TO COMMUNICATION AND COORDINATION IN DISASTER RESPONSE: A DELPHI STUDY

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ABSTRACT
Multi-organizational ad hoc knowledge networks have the potential to improve the effectiveness of disaster response and recovery by helping organizations share information, coordinate their activities and leverage participants’ expertise. This paper reports an exploratory study to identify the major barriers to effectiveness in ad hoc knowledge networks in disaster response. The research methodology is a multi-panel Delphi survey, with each panel comprised of experienced emergency response professionals from different types of response organizations (e.g., fire fighters, EOC (emergency operations center) directors, law enforcement professionals). The study is currently in progress, and results from the first two panels are reported.

Keywords
Disaster response, knowledge networks, Delphi survey, situational constraints

INTRODUCTION
Effective ad hoc knowledge collaboration is a critical element in successful response to disasters, both to reduce human and property losses in the immediate aftermath of an extreme event and to restore the functionality of critical systems and to meet social needs during subsequent recovery efforts (Hiltz, Van de Walle and Turow, 2010). The environment in which these critical knowledge processes take place, however, presents difficult challenges to the coordination of knowledge and expertise among the organizations involved in response efforts (e.g., federal/state/local agencies, medical facilities, voluntary organizations). Factors contributing to the complexity of these environments are: 1) the diffusion of knowledge and expertise across the network, 2) a variety of formal and informal communication channels, 3) a changing set of participating organizations, and 4) different organizational roles and goals. Network dynamics also contribute greatly to the complexity of the knowledge ecology of disaster response by presenting additional challenges to collaborative information sharing including: an evolving network structure and membership, changing task requirements and resources, and changing knowledge requirements and capabilities. This study is part of a research project to: 1) identify obstacles to inter-organizational communication and coordination in disaster response, 2) investigate the use of knowledge networks across phases of disaster response (e.g., immediate response and sustained recovery efforts), and 3) develop actionable strategies to improve effectiveness. The current study focuses on the first objective, the identification of barriers encountered by different types of response organizations.

While prior research has highlighted the importance of ad hoc knowledge collaboration in disaster response and identified some of the barriers encountered in these situations, the majority of this work has examined the topic within the context of a specific event through after-action reports (e.g., Chua et al., 2007; Dawes et al., 2004; McEntire, 2002). In contrast, our research takes a different approach by examining the topic from the perspective of different types of response organizations (e.g., local government, voluntary organizations such as the Red Cross) and different professions involved in disaster response (e.g., law enforcement, EMT, fire fighters). Our goal is to gain insights into the challenges of ad hoc knowledge collaboration encountered by specific types of organizations and occupational groups that may arise, for example, from factors such as characteristics of organizational and occupational cultures, and the specific roles and mode of engagement with other types of organizations/response professionals. Through this approach, our objective is to enhance and elaborate the understandings of prior research on interorganizational coordination and collaboration. The study described in this paper represents an initial step in that direction. As a starting point, we are conducting an exploratory Delphi survey with multiple panels representing various types of response organizations and response professions. At this time, two panels have been surveyed – firefighters who have had experience in responding to major disasters and EOC Directors from parishes in the
State of Louisiana. A third panel of law enforcement professionals is being formed. Other panels planned include EMTs and leadership of voluntary organizations involved in disaster response.

RESEARCH APPROACH – RANKING-TYPE DELPHI SURVEY

The research strategy used for the study is a “ranking-type” Delphi study. The Delphi method was developed as a technique to obtain the most reliable consensus of a group of experts (Dalkey and Helmer, 1963). The method provides a structured communication process that includes: 1) feedback of individual contributions of information and knowledge, 2) assessment of the group judgment or view, 3) opportunity for individuals to revise views, and 4) anonymity of individual responses (Linstone and Turoff, 1975). The “ranking-type” variation of the Delphi method variation is commonly used to identify and prioritize issues related to a complex problem (see, e.g., Branchau, Janz and Wetherbe, 1996; Schmidt, Lyytinen, Keil and Cule, 2001). The methodology used for the current study follows guidelines developed by Schmidt (1997) for conducting a ranking style Delphi study, as detailed in the following section. Multiple expert panels were formed in order to identify similarities and differences in the issues encountered by different types of response organizations.

METHODOLOGY

This section describes the survey methodology followed for each of the expert panels and presents the results of the first two panels: 1) fire fighters, and 2) Louisiana parish EOC Directors.

Selection of Expert Panelists

Expert panelists were identified by referral or by role/position. The criterion for panel participation was that the individual have significant experience in disaster response, including major disasters. We focused on soliciting members of the disaster responder community in the Gulf South, particularly in Louisiana, because of their recent experiences responding to the major events of Hurricanes Katrina and Gustav/Ike. Identification of participants for the fire fighter panel was through referral by the leadership of the Fire and Emergency Training Institute (FETI) at Louisiana State University. For the second panel, e-mails were sent to the parish EOC Directors of Louisiana parishes inviting their participation in the study. (Parishes are similar to counties in other states.) Parish EOC Directors are responsible for coordinating the overall parish response to an emergency.

Table 1 shows that panelists on each of the panels had considerable depth of emergency response experience. All panelists were involved in at least one major disaster response operation (e.g., Katrina/Rita, Gustav/Ike) and most had participated in emergency response for multiple disaster events. Diverse backgrounds and perspectives in terms of different roles and types of disasters were represented on each of the panels.

<table>
<thead>
<tr>
<th>Number of panelists</th>
<th>Fire Fighter Panel</th>
<th>EOC Directors Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of panelists</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Average years of experience in the fire fighting profession/in emergency response</td>
<td>21.3 years</td>
<td>19.3 years</td>
</tr>
<tr>
<td>Participation in emergency response to major disasters</td>
<td>Hurricane Katrina (3); Hurricanes Ike/Gustav (5); Other (3)</td>
<td>Hurricane Katrina (6); Hurricanes Ike/Gustav (6); Other (more than 15)</td>
</tr>
</tbody>
</table>

Table 1. Demographics – Panel Participants

Survey Procedure

A ranking-style Delphi survey involves a multi-step process: discovery of issues, determining the most important issues, and ranking of issues (Schmidt, 1997). The initial step is independent brainstorming by panelists. Next, the researchers categorize the input and identify the most important issues. Panelists are then asked to rank the issues by order of importance and to provide input about the rationale for their ranking. Next, the degree of consensus is assessed by the researchers and results are presented to the participants. Panelists are then asked to review/consider the group results of the initial ranking and then re-rank the lists. The goal of the multi-round ranking process is to shape a group consensus. For this study, there were two rounds of ranking.

We used the Qualtrics™ Research Suite software to conduct the Delphi survey on-line, which yielded the benefit of decreased data collection time. Invitation letters containing a link for the initial web-based questionnaire were sent to
qualified panelists. After a few days, a reminder invitation e-mail was sent to potential panelists who had not yet responded to increase the response rate.

**Survey 1 (discovery of issues):** In the first survey, panelists were asked to describe 6-10 major barriers/obstacles to inter-organizational communication and coordination for disaster response (in the immediate aftermath of an event and the period shortly following the event). They were also asked to provide information about their emergency response experience.

For each panel the input data was consolidated into a single list and then grouped by topic and assigned a descriptive label. (Classification and labeling was done by one of the researchers and reviewed by the other researchers.) For example, a Leadership Capabilities Issues category included input such as: “Those in command are not emergency responders. They are administrators.” and “Those in charge do not fully understand the system in which they work.” This step produced a list of 18 issues for the fire fighter panel, and 20 issues for the EOC director panel.

**Survey 2 (issues ranking – round 1):** In the second survey, panelists were asked to rank the issues identified by their panel in order of importance. All issues were retained after round 2 since Schmidt (1997) suggests 20 as a manageable number to rank. We first listed the full set of categorized input (category labels and individual comments), in alphabetical order. Next, panelists were asked to rank the issues from 1-N in order of importance from the most to the least important. In order to avoid any ordering effects, issues were presented in random order for the ranking step.

Analysis of the ranking data included calculation of: 1) mean rank for each item, 2) percentage of respondents placing each item in the top half of their list, and 3) Kendall’s W (coefficient of concordance) to assess the overall level of consensus. Kendall’s W for the initial ranking of issues by the fire fighter panel was .50, indicating moderate agreement among panel members, and .25 for the EOC director panel, indicating weak agreement. One reason for the low level of agreement among EOC Directors may be that Directors come from different responder specialty areas.

**Survey 3 (issues ranking – round 2):** The third round involved reconsideration and re-ranking of the issues by the panelists. Issues (category labels and initial input) were presented as in the previous survey, with the addition of the mean rank and percentage of respondents placing the item in the top half of their list. The level of agreement from the previous ranking, based on Kendall’s W, was also described.

Kendall’s W for the re-ranking of issues by the firefighter panel was .40, less than the prior round, indicating weak/moderate agreement. In a Delphi study, the level of agreement typically increases with each ranking round as participants review the rankings of others and reconsider their previous rankings. In order to understand why this was not the case for this panel, we will review the individual ranking changes in more detail and also explore this in our follow-on interviews. Multiple ranking rounds in a Delphi study typically result in a higher EOC director panel re-ranking of issues is currently in progress.

**RESULTS TO DATE**

Results of the issues ranking by the two expert panels are shown in Table 2 and Table 3 on the following pages. It is premature to draw conclusions from the limited dataset collected to date, but some preliminary observations can be made. At a general level, it is clear that there are commonalities in the types of obstacles and barriers encountered by the fire fighters and EOC Directors. There are also, however, variations in the specific issues encountered within each type. As a first step in identifying these commonalities and differences, we will apply a framework drawn from the organizational behavior literature. The Situational Constraints framework was developed to understand the types of situational constraints that affect individual work performance (see, e.g., Peters and O’Connor, 1980; Villanova and Roman, 1993). One variant of the framework (from Peters and O’Connor, 1980) identifies eight categories of situational constraints. These categories are shown in Table 4. Although the framework was developed to apply to the level of an individual worker, the same categories will be useful in analyzing the results of the current study to understand situational constraints encountered by organizations in disaster response. Another important step in interpretation of the findings will be to use theory and concepts drawn from the knowledge management and interorganizational communication/coordination literatures. Finally, we will present the output of our analysis to the panel participants for their review and any additional feedback/comments.

It is important to note that one of the limitations of the study in terms of generalizability is the inclusion of panelists from a single geographic region. While the members of the firefighter panel have worked in a variety of locales, the emergency management experience of the EOC Director panelists has been almost exclusively in Louisiana. Some types of issues (e.g., problems with radio systems) may be more/less severe in different regions.

As a follow-on study to deepen our understanding of these issues, we will be conducting facilitated focus group sessions with emergency response professionals attending the National Evacuation Conference to be held in New Orleans in February 2010. In these sessions, we will use the cognitive mapping technique to understand the causal relationships between factors affecting coordination and collaboration in ad hoc knowledge networks in disaster response. The final phase of the research...
will be to identify actionable strategies that can be used to address the barriers and obstacles identified through the Delphi survey and focus groups. A primary source for potential strategies to enable changes and improvements by first responder agencies and coordinating groups will be theory drawn from the management, knowledge management, organization science, and inter-organizational communications literatures. A critical element in this step of the research will be to adapt the insights of work in more traditional organizational contexts to reflect and address the characteristics of these complex dynamic organizations, such as rapid obsolescence of information, the emotionality of the situation and inability to observe the actions of other members (Majchrzak et al., 2007).

<table>
<thead>
<tr>
<th>Issue Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1-N)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mean Rank</th>
</tr>
</thead>
</table>

| Issue Category |

| Example Input |

| (direct quotes) |

| 1 | 2.83 | Leadership capabilities issues | Agencies/organizational leaders are often unfamiliar with the capabilities and needs of their people, equipment and resources. |
| 2 | 3.50 | Command system issues | Failure of responders, governmental bodies and NGOs to effectively use incident management system structure in an appropriate manner. |
| 3 | 5.17 | Decision-making issues | Organization not sending personnel with the authority to make the decision of the organization to the table. |
| 4 | 6.00 | Lack of planning/preparedness | Organizations not planning for emergencies and not testing their plans to see if they work. |
| 5 | 6.67 | Communication equipment issues | Short supply of communication equipment. |
| 6/7 (tie) | 7.33 | Bureaucracy/red tape | Too much red tape. When the time comes, it needs to get done. |
| 6/7 (tie) | 7.33 | Resource issues/logistics | Lack of forward-deployed resources and equipment. |
| 8 | 8.33 | Training issues | Organizations not trained in NIMS (National Incident Management System). |
| 9/10 (tie) | 9.00 | Manpower issues | Available funding for small volunteer services during a disaster. |
| 9/10 (tie) | 9.00 | Radio communications issues | Lack common radio channels. |
| 11 | 9.50 | Poor communication (general) | If responders are not able to communicate, tasks or strategies are not likely to get completed efficiently. |
| 12 | 10.83 | Lack of reliable information | Lack of reliable intel from affected areas. |
| 13 | 11.67 | Inaccurate resource/contact information | No accurate list of equipment or trained personnel within the state. |
| 14 | 12.50 | Jurisdictional disputes/own agendas | Not looking at the big picture of the incident – only looking at their own agenda. |
| 15 | 13.00 | Organizational priorities issues | Too much importance is given to certain branches, even when they are not the experts/specialists at the task at hand. |
| 16 | 13.50 | Interoperability issues | Not testing their equipment with other organizations to ensure compatibility. |
| 17 | 15.17 | Outside responders issues | Uncoordinated response from outside first responders and the lack of tracking of such resources. |
| 18 | 15.33 | Terminology differences | Different terminology of the organizations. |

Table 2. Issues and Ranking – Fire Fighter Panel – Final Round
<table>
<thead>
<tr>
<th>Issue Rank (1-N)</th>
<th>Mean Rank</th>
<th>Issue Category</th>
<th>Example Input (direct quotes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.67</td>
<td>Inadequate funding</td>
<td>A lack of funding for a sector of the local government that is only of use when things go wrong and then the people think you should solve all their problems.</td>
</tr>
<tr>
<td>2</td>
<td>5.83</td>
<td>Lack of training and certification for emergency managers</td>
<td>Lack of training and certification for emergency managers. The issue is beginning to be addressed but much needs to be done.</td>
</tr>
<tr>
<td>3</td>
<td>6.83</td>
<td>Unprepared agencies’ requests for assistance</td>
<td>Unprepared agencies requesting assistance with minute assets immediately following an event that should have been gathered prior to an event.</td>
</tr>
<tr>
<td>4</td>
<td>7.00</td>
<td>Circumventing parish EOC</td>
<td>Municipal elected officials attempting to circumvent parish EOC for assistance and assets.</td>
</tr>
<tr>
<td>5</td>
<td>7.83</td>
<td>Staffing/personnel issues</td>
<td>State EOC bringing in multitudes of inexperienced guardsmen to answer calls who are unfamiliar with the key players in State EOC.</td>
</tr>
<tr>
<td>6</td>
<td>8.17</td>
<td>Communications equipment interoperability/reliability</td>
<td>All agencies on one network or radio system so that you don’t have to carry/use different systems.</td>
</tr>
<tr>
<td>7</td>
<td>8.67</td>
<td>Responder fatigue, mental stress and nutrition</td>
<td>Low morale sets in with first responders if human resources are not properly managed for rest and nutrition.</td>
</tr>
<tr>
<td>8</td>
<td>9.33</td>
<td>Perceptions of the public</td>
<td>Perceptions of the public. We do not do a good job selling ourselves to the public.</td>
</tr>
<tr>
<td>9</td>
<td>10.00</td>
<td>Multiple agency requests for shelter information</td>
<td>Shelter reporting. Have one group responsible for collecting shelter information, not each state agency making their own requests.</td>
</tr>
<tr>
<td>10/11 (tie)</td>
<td>11.00</td>
<td>State and/or FEMA doubting initial damage reports</td>
<td>I attribute delays in our parish receiving initial commodities and supplies due to this disbelief.</td>
</tr>
<tr>
<td>10/11 (tie)</td>
<td>11.00</td>
<td>Unclear expectations for EOC Directors</td>
<td>Understanding what is actually needed or expected as a result of your participation.</td>
</tr>
<tr>
<td>12</td>
<td>11.50</td>
<td>Problems communicating/sharing among agencies (general)</td>
<td>Inability to contact the key players in the (state) EOC that parish directors normally deal with.</td>
</tr>
<tr>
<td>13</td>
<td>12.17</td>
<td>Space issues in EOC to house all agencies needed</td>
<td>Space issues EOC to house all agencies needed to respond to a disaster.</td>
</tr>
<tr>
<td>14</td>
<td>13.50</td>
<td>Confusion about what information is official</td>
<td>Confusing about what information is “official information.”</td>
</tr>
<tr>
<td>15/16 (tie)</td>
<td>13.67</td>
<td>Difficulty getting accurate information from rural areas</td>
<td>Inability to get an accurate report of the totality of the damage from the rural areas of the parish.</td>
</tr>
<tr>
<td>15/16 (tie)</td>
<td>13.67</td>
<td>Politics and turf battles</td>
<td>As an Emergency Management Director you get hammered when it is perceived that one entity receives something that someone else didn’t get, no matter what the reason is.</td>
</tr>
<tr>
<td>17</td>
<td>14.33</td>
<td>Space issues - shelters</td>
<td>Insufficient space for special-needs shelters</td>
</tr>
<tr>
<td>18</td>
<td>14.50</td>
<td>Media outlets - communications and coverage</td>
<td>Media outlets calling parish EOC/JIC continuously.</td>
</tr>
<tr>
<td>19</td>
<td>14.67</td>
<td>Decision making issues</td>
<td>FEMA liaison to parish not given enough authority to expedite needs requests.</td>
</tr>
<tr>
<td>20</td>
<td>15.17</td>
<td>Infrastructure damage</td>
<td>Damage to infrastructure that cannot easily be restored or replaced.</td>
</tr>
</tbody>
</table>

Table 3. Issues and Ranking – Parish EOC Directors Panel – Initial Ranking Round
1. Job-Related Information
2. Tools and Equipment
3. Materials and Supplies
4. Budgetary Support
5. Required Services and Help from Others
6. Task Preparation
7. Time Availability
8. Work Environment

Table 4. Situational Constraints/Resource Variables
(from Peters and O’Connor, 1980)

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DISCLAIMER
The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the US Department of Homeland Security.

REFERENCES
ON THE APPROPRIATENESS OF THEORY BORROWING IN IS: AN INTERDISCIPLINARY EVALUATION

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ABSTRACT
This essay discusses whether “stealing” theories from other disciplines should always be avoided or whether there is any appropriate way of using theories developed in other disciplines in an information systems (IS) context. We take a look at the benefits and problems that have arisen in the IS field as a result of theory borrowing and suggest that – when done appropriately – such borrowing may well benefit the field. In the process, we also draw on the marketing and psychology literatures to evaluate the adequacy of theory borrowing in general and derive specific recommendations about what appropriate borrowing could look like. By synthesizing concepts from these literatures, we derive a comprehensive set of recommendations that may improve the process of theory borrowing in the field; thereby moving the discipline forward.

Keywords
Theory borrowing, Reference disciplines, Anxiety discourse, Diversity

INTRODUCTION
When being among researchers from other business disciplines, information systems (IS) scholars often face the necessity to justify their field and research. In particular, scholars from other disciplines often indicate that IS researchers do not develop any theory on their own, but much rather simply steal theory from other fields like a “band of gypsies” – and even do so in an inadequate way.

This essay reflects on both the results and the process of theory borrowing in the IS field. By utilizing the knowledge that has been created in some of the IS field’s major reference disciplines on the process and adequacy of theory borrowing and by synthesizing this knowledge with IS concepts, we derive a comprehensive set of recommendations for future theory borrowing in IS. We further illustrate how these recommendations could be put into practice and provide examples of extensions IS research has made to major theoretical lenses it borrowed. By making these extensions, IS scholarship contributes back to its reference disciplines. Together, the concepts discussed here may move the IS discipline forward; at the minimum, they provide solid arguments for IS scholars to succinctly justify their field and research.

IS THEORY BORROWING MEANINGFUL FOR THE IS FIELD?
Since its inception, IS scholarship has heavily “borrowed” theories from other disciplines. Theory borrowing refers to a process in which a theory belonging to a specific social context and being used to explain a specific phenomenon is used in another context to explain a different phenomenon (Murray and Evers, 1989). While the IS field’s reliance on theory borrowing is reasonable given that IS research originated from a variety of backgrounds (Swanson and Ramiller, 1993) and consists of a variety of distinct theoretical clusters rather than a single core (Lim, Saldanha, Malladi and Melville, 2009), only some of this borrowing appears appropriate. After the inception of the discipline, IS scholars have been under high pressure for both research productivity and methodological rigor. By relying on theories from other disciplines, they increased either (Benbasat and Weber, 1996).

At the same time, however, this borrowing of theories from other fields led to a scarcity of true IS theories. Of the more than fifty theories used in IS as listed on the AISWorld website (http://www.istheory.yorku.ca/), only four are described as having originated primarily in IS: task closure, task-technology fit, the technology acceptance model, and the unified theory of acceptance and use of technology. Note that these latter theories’ roots lie in cognitive psychology. Even if a few more are
claimed, for example Nolan’s (1979) stages of growth theory, the number of IS theories is “depressingly” small (Markus and Saunders, 2007, pp. iii-vi).

Aware of this problem, IS scholars often point to Keen (1980) to justify their adoption of theories from other fields, which are often referred to as reference disciplines (R.D.). Yet, this excuse reveals a misinterpretation of Keen’s ideals. In fact, his main idea was that IS scholars look at R.D. to benchmark with respect to research quality, not borrowing and tweaking other’s theories into IS.

Consider what Keen (1980, pp. 10-11) said: “An R.D. is an established field to which one looks to get an idea of what good MIS research would look like, if one could ever do it. (...) A main weakness of MIS is that we have no clear criteria for evaluating our research. (...) It is essential then to look at that field (a R.D.) in detail, not necessarily adopting its theories and methods but at least assessing what they imply for our own work. (...) Information economics, (...), may be an excellent R.D. for those concerned with theory for MIS, since it demonstrates how to approach the issue of defining information and presents an analytic strategy for developing and applying theory. (...) The reference discipline is only a reference. Research that is firmly grounded in a given field may not contribute to our understanding (...).” (Italic emphasis added). When reading Keen’s whole section on R.D., a recurrent theme surfaces: R.D. are a means to evaluate the quality of IS research.

Due to the misunderstanding of Keen’s ideals, the reliance on theories from R.D. has evolved into a double-edged sword. It initially helped the IS field improving output and rigor, but at the same time led to a deserted landscape of IS theories. Clearly then, there is no one true answer as to whether adopting theories from R.D. is good and meaningful or bad for the IS discipline. However, there undoubtedly are better and worse ways of borrowing theories.

HOW CAN THEORY BE BORROWED APPROPRIATELY?

Appropriate theory borrowing involves one key term: explicit reflection. Explicit reflection enhances consistency among theory objectives, research philosophy, and social context. It revolves around seven basic elements implied in the use of borrowed theory in IS (Murray and Evers, 1989; Truex, Holmström and Keil, 2006):

1. To what degree does the theory selected for adaptation fit the phenomenon of interest?
2. Which theory elements (i.e., theory objectives/proposition, research philosophy, and social context) change as a result of the borrowing process?
3. To what extent do these changes result in inconsistencies?
4. What are the consequences of potential inconsistencies?
5. Exploration of ways to resolve potentially problematic inconsistencies.
6. Exploration of the possibility that the original theory was also borrowed.
7. To what degree does the borrowing contribute to cumulative theory (i.e., the degree to which the research goes beyond the already known)?

Theory borrowing that explicitly reflects on these elements can be considered informed and purposeful and will likely benefit IS research. Jones and Karsten’s (2008) review article constitutes a good example. The entire article is devoted to explicit reflection on the use of structuration theory in IS research. Jones and Karsten reflect on the fit of structuration theory to IS phenomena, on potential inconsistencies among theory elements and consequences of inconsistencies, and on the implications of the origins of the theory for IS research. Overall, they critically and comprehensively evaluate the theory’s potential for IS scholarship. From this explicit reflection, they develop an IS-specific version of the theory. Subsequently, they derive a research agenda for structurational IS research, thereby clearly contributing to cumulative research. Similar contributions can be claimed for adaptive structuration theory (e.g., Bostrom, Gupta and Thomas, 2009; Markus and Silver, 2008).

Wade and Hulland’s (2004) review of the resource-based view of the firm (Barney, 1991; Wernerfelt, 1984) is another good example. The authors not only reflect on the theory’s fit to IS research, but also make problematic assumptions explicit (i.e., the theory assumes to a substantial extent that resources act in isolation). Wade and Hulland (2004) then develop propositions in light of these assumptions; thereby contributing to cumulative IS research.

By contrast, random and opportunistic theory borrowing will likely have the opposite effect and will increase the likelihood of generating misleading ideas. Far too often, IS scholars have borrowed theory without sufficient reflection on the associated underlying assumptions (Truex et al., 2006), particularly in empirical research. This insufficient reflection may not be surprising since the stringent page limits for empirical IS articles may clearly limit IS scholars’ possibilities for explicit
Reflection. By contrast, Jones and Karsten (2008) as well as Wade and Hulland (2004) had sufficient journal space available to present the issues involved since they developed conceptual rather than empirical work.

This comparison could reveal the preferred approach to borrowing: reflection on a theory in a full length review article before its adoption in an empirical study. Consistent with this notion, Markus and Saunders (2007) declared adequate borrowing a prime reason for initiating the MISQ Theory and Review department.

WHERE HAVE IS SCHOLARS MADE SUBSTANTIAL CONTRIBUTIONS TO THEORY AS A RESULT OF BORROWING?

While IS scholars engage in extensive theory-borrowing from reference disciplines, they also extend the theories they borrow in important and unique ways. IS scholars thereby make substantial theoretical contributions, which should be acknowledged whenever IS research is judged. Consider the following examples of extensions IS scholarship made to key management theories; thereby contributing back to the reference disciplines from which these theories were initially borrowed.

1. Beginning with Mata, Fuerst and Barney’s (1995) seminal paper on IT value, IS scholars made ample use of the resource-based view of the firm (RBV) (Barney, 1991; Wernerfelt, 1984). As a result, they offered one particularly noteworthy extension to RBV: the explicit recognition of resource interactions. The process leading up to this extension unfolded as follows. By applying RBV to the study of IT value, IS researchers concluded as early as 1995 that IT investments by themselves are unlikely to provide competitive advantage. According to RBV, resources yield competitive advantage if they are valuable and heterogeneously distributed across competing firms. This competitive advantage can be sustained if the resources are also imperfectly mobile. While some IT capabilities can satisfy these criteria, IT assets generally do not (Mata et al., 1995). As the research stream progressed, IS scholars learned that IT resources (i.e., IT assets and capabilities) have competitive value primarily in leveraging complementary organizational resources (Bharadwaj, 2000; Melville, Kraemer and Gurbaxani, 2004). IS researchers therefore needed a lens to examine the competitive potential of resource interactions. Because the traditional RBV school of thought assumed that resources act in isolation (Wade and Hulland, 2004), it was no longer adequate.

To overcome the problem inherent in the traditional RBV, Wade and Hulland (2004) extend the theory by introducing key moderators for the relationship between IT resources and firm performance. These moderators include, among others, organizational and environmental factors. Due to their general nature, these moderators may be used in other management fields as well. Nonetheless, other disciplines might have never extended RBV in this way. As Wade and Hulland point out, the study of resource interactions is particularly pertinent to IS scholarship since – similar to electricity (Carr, 2003) – IT assets by themselves are neither rare nor causally ambiguous.

It deserves mentioning that some would claim the knowledge-based view (KBV) as yet another extension IS scholars made to RBV. In 1996, Conner and Prahalad recognized the centrality of the knowledge resource to organizational success and therefore extended RBV to KBV. However, given that their article was published in Organization Science and that they address the management literature at large with particular emphasis on strategy research, this claim appears unjustified.

2. IS scholars extensively researched the potential of real options for risk mitigation and thereby extended real options theory (ROT) (Amram and Kulatilaka, 1999). More specifically, they examined the potential of options for risk mitigation in general (Fichman, 2004) as well as for the mitigation of specific risk factors (e.g., Benaroch, 2002). By focusing on the latter, IS researchers developed the option-based risk management (OBRiM) framework (Benaroch, 2002; Benaroch, Lichtenstein and Robinson, 2006), which maps specific options to specific project risk factors. For example, OBRiM indicates that the risk inherent in investment complexity can more effectively be mitigated through prototype and outsource options than through project abandonment. OBRiM thus deepens understanding of the value of ROT for project management in general and for risk mitigation in particular. By positing these mappings on the basis of theoretical rationales, OBRiM extends ROT.

So, why is this expansion of the scope of ROT to include a risk mitigation mapping pertinent and unique to IS research? One reason is that IT investments are far riskier than other organizational investments (Dewan, Shi and Gurbaxani, 2007), thereby making risk-mitigation particularly relevant to IT investments1. Another reason may lie in the modularity of the IT resource. Because of its inherent modularity, IT is a particularly strong option-enabler. For example, IT investments can easily embed an explore option through the use of a pilot investment (Benaroch, 2002). An explore option involves testing the IT in small scale before the full investment is made. In consequence, ROT lends itself to the study of IS phenomena.

3. The theory of IT-culture conflict (Leidner and Kayworth, 2006) constitutes another extension. It explicitly assumes that culture surfaces when the values held by an IT are in conflict with those held by an individual. The theory thus explicates that

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1 One reason for the greater riskiness of IT investments could lie in the socio-technical nature of such investments. Because IT can be interpreted flexibly (Orlikowski and Robey, 1991), payoffs to IT investment are difficult to predict.
culture goes largely unnoticed and surfaces only in the event of conflict arising from the interaction between two incompatible cultures. While the broader management literature had long recognized this aspect of culture (Hofstede, 1980), such recognition was merely implicit (Leidner and Kayworth, 2006). In particular, management research did not explicitly examine the forms of conflict through which culture surfaces. Hence, IS research extended cross-cultural management theory through the explicit recognition of conflict and the illumination of one specific form of conflict that leads culture to surface.

The IS field may have been more likely than other management disciplines to make this addition to theory since social interactions with IT may be particularly likely to generate conflict. Consider the users of an IT. As any group that encounters a counterculture, users might experience cultural conflict regarding the adoption of an IT when conflicting values were embedded in the technology by the group responsible for developing or championing it. This aspect indicates that cultural conflict is at least as relevant to IS research as it is to other fields. Yet, in addition to this aspect, any IT itself is in sharp conflict with basic human values in many cultures. Specifically, since IT is inherently risky (Leidner and Kayworth, 2006), the many cultures uncomfortable with uncertainty (Hofstede, 1980) are likely to associate conflict with its use. For instance, Thatcher, Srite, Stepina and Liu (2003) found that persons who avoid uncertainty are unlikely to innovate with new IT. Because these socio-technical interactions that are unique to IS research (Lee, 2001) are particularly likely to generate conflict, the IS field may have been especially pertinent to make this addition to management theory.

4. Perhaps most noteworthy, IS scholarship has taken the lead in moving innovation research forward (Fichman, 2000). IS researchers added numerous factors such as top management support and centralization to the study of innovations (Fichman, 2000). More importantly, in recognition that IT innovations are distinct from other innovations by degree of complexity, IS researchers extended the classical diffusion of innovations theory (DOI) to better reflect the nature of highly complex innovations such as IT. Two such extensions are particularly worth mentioning: the explicit study of two-part adoption decisions as well as knowledge barriers (Fichman, 2000).

The explicit study of two-part adoption decisions resulted from the recognition that the complexity inherent in IT may lead to ambiguity in determining the rate of diffusion of an innovation. The question arose of at what point an organization had truly adopted an innovation. By explicitly outlining the adoption process as being composed of two parts, organizational and individual adoption, IS research reduced the ambiguity inherent in determining the rate of diffusion of complex innovations. Specifically, Cooper and Zmud (1990) indicated that the adoption of innovations progresses through six stages, where the first three stages are more reflective of organizational adoption and the subsequent stages are more reflective of individual adoption. This stages-of-diffusion model greatly enhanced the specificity with which the diffusion of an innovation could be determined. For example, rather than finding that – on average – an innovation’s diffusion has progressed “far beyond initial acquisition”, IS scholars could now specify that innovation diffusion has reached the stage of “routinization” (i.e., routine use of the technology by individuals). Also due to the complexity inherent in IT innovations, IS scholars added the explicit recognition of knowledge barriers to innovation research. For example, Ravichandran (2005) found that inter-organizational knowledge sharing increases innovation diffusion through the reduction of knowledge gaps.

These two complexity-related extensions may have been more likely to originate from the IS field than from other management disciplines. Because IT can be interpreted flexibly (Orlikowski and Robey, 1991) and often includes vast amounts of functionality (Jasperson, Carter and Zmud, 2005), it is more complex than many other technological innovations. Therefore, IT lends itself to the study of two-part adoption decisions. While IT use can be organizationally mandated to some extent, adoption decisions by individuals play a major role in determining deep use. IT furthermore lends itself to the study of knowledge barriers. While all technological innovation requires organizational learning to some extent, the complexity inherent in much IT places particularly high demands on organizational knowledge and skills (Fichman, 2000; Orlikowski and Robey, 1991). This is perhaps evidenced by the fact that IT functionality is often underutilized (Jasperson et al., 2005).

Swanson (1994) made a perhaps even greater extension to organizational innovation research. He extended the dual-core model of organizational innovation (Daft, 1978) to incorporate a third element – the functional IS core. The IS core constitutes more than just any element that could have been included; it serves a special role. Because of the high level of plasticity inherent in IT for informational layering and organizational connecting in general, the IS core serves as the natural linkage between the two traditional cores – business support and core processes.

The IS core thus enables a previously not explicitly considered concept in innovation research: innovation spawning. This concept indicates that more strategic innovations such as KM strongly spawn less strategic ones like the acquisition of basic IT infrastructure. Likewise, less strategic innovations still spawn more strategic ones, although to a weaker extent. The extension of the dual-core model along with the concept of innovation spawning was especially likely to originate in IS since IT more than other innovations links core and support processes, thereby enabling spawning effects. By contrast, if these processes were not linked to a substantial extent, innovation spawning would not be conceivable since its very nature demands the linkage.
CONCLUSION

Let us conclude with indicating that IS scholars do not need to condemn their theory-borrowing mentality. In fact, theory borrowing from more established disciplines is important for relatively new interdisciplinary fields, such as IS (Murray and Evers, 1989). Further, inadequate borrowing is under no circumstances unique to IS. Consider early consumer behaviorists, who have borrowed many of their theories from psychology, often in a random and opportunistic way. For example, they misborrowed Freudian psychoanalytic theory; a theory that was originally developed to help disturbed patients was used to explain the behaviors of typical consumers, indicating a clear mismatch in theory objectives. However, although marketing in general has continued to borrow many of its concepts from other disciplines, it has evolved into a legitimate field (Murray and Evers, 1989). Accordingly, initial misborrowing might simply be part of a learning process, where a field has to develop the skill of appropriate adaptation of theories over time.

ACKNOWLEDGMENTS

We thank all committee members and volunteers for their hard work and contributions to the conference.

REFERENCES


A SOCIAL NETWORK ANALYSIS OF THE IS FIELD: A CO-AUTHORSHIP NETWORK STUDY

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ABSTRACT

The IS field is a fragmented field with many different research strategies and topics. To complicate this matter, there are many different publication venues and geographic locations. This study will try to look at the co-authorship social network (SN), using three different venues. One of the venues is the top journal in our field, the other a regional conference, and the third is a top French IS journal. The study will take a social network analysis (SNA) approach to see if there are differences in these venues and to take a preliminary look at the IS field. The results indicate that even though we research under the umbrella of IS, differing venues seem to have differing cliques of researchers. The divide between North American and France is also seen in how different the publication strategies seem to be between the two geographic areas.

Keywords

Social Network, Network Analysis, MIS Quarterly, SAIS, Systèmes d'Information et Management

INTRODUCTION

The study of how researchers conduct research is of importance to any field. In particular social network analysis of academic publishing has been conducted in the fields of marketing (Pieters et al. 1999), and information systems (IS) (Nerur et al. 2005; Polites et al. 2008; Song et al. 2008; Vidgen et al. 2007). Within IS the network analysis can be extended to knowledge management (KM) (Song et al. 2008). Outside of academics there have been studies on online social networks (Howard 2008; Kleinberg 2008), geographic spread of social networks (Liben-Nowell et al. 2005).

Research in academia is invariably a social phenomenon. There are two methods in which to publish, whether you use co-authors or solo-author. Either way there is invariably social connections being made. When a paper has co-authors, the authors are socially connected via co-authorship. When solo-authoring social connections are still citations being used. Whether you co-author or solo-author, the majority of papers in academia today have citations and thus a social connection via intellectual recognition. By the use of citations an author is giving credit to a thought, taking thoughts from various different sources, combining these thoughts to complete a different point (Callon et al. 1981). When we cite one another we are creating a social connection via citations to other authors.

REVIEW OF METHODS TO STUDY SOCIAL CONNECTIONS VIA SNA

There are also two major ways in which social network analysis can be utilized for analyzing social connection in academic publishing. One connection is via the co-authorship. Connections are made when two or more people agree to collaborate on a project. During co-authorship network analysis, all co-authors are assumed to know each other. Some characteristics of the two types of connections are that with co-authors, you have stronger bonds, less connections, but the strength of the connections may not be seen. With co-citation analysis, the connections are weaker, typically there are more connections, and the strength of connections cannot be seen as well.

The use of network analysis has stretched from neurobiology, statistical physics, to the notion of ‘six degrees of separation’, and games such as ‘six degrees of Kevin Bacon’ that try to link different actors to the famous actor (Guare 1992; Liben-Nowell et al. 2005; Strogatz 2001). The term ‘six degrees of separation’ coined by Guare (1992) is really a phrase for the ‘Small World Problem’ by Travers and Milgram (1969), where they found that everyone in a large society were connected in some way by about 5.5 linkages (Travers et al. 1969). Even in information systems (IS) social network analysis has been applied (Nerur et al. 2005; Polites et al. 2008). With the advent of social networking sites such as myspace.com and friendster.com, social network analysis has been applied to these sites as well (Howard 2008; Kleinberg 2008). Social network analysis has its advantages. “However, one of SNA’s advantages is that it can in fact uncover subtle, unrecognized relationships between journals, and thus can aid in the development of more accurate classification schemes in the future” (Polites et al. 2008, Page 99).
Typically social network analysis of academia has been limited to two types of research, those that look at journal citation networks, and those that look at co-authorship networks. In journal citation networks, journals are the units (nodes) and how articles in each journal cite other journals is analyzed for a period of time (Biehl et al. 2006; Nerur et al. 2005; Pieters et al. 1999). In co-authorship networks, authors are the units (nodes) and the tendency of authors that co-author to continue to publish in a similar fashion or to a similar outlet are analyzed (Acedo et al. 2006; Barbasi et al. 2002; Eaton et al. 1999). The author acknowledges that there are many other areas of SNA that aren’t covered due to the length of this article.

Several aspects of the SNA are looked at. The node, edge, connectivity, and distance are identified. A node is defined as a point on the network (Barbasi et al. 1999; Coleman 1988; Kleinberg 2000; Travers et al. 1969). For this research a node is a researcher. An edge of a network is defined as a line connecting two nodes (Barbasi et al. 1999; Coleman 1988; Kleinberg 2000; Travers et al. 1969). An edge can be non-directional, directional, or bidirectional. For example co-authorship will be shown as a non-directional edge. Citations can be shown as a directional edge. If author A cites author B, and author B cites author A, a bidirectional edge will be used. In the current study an edge is a line connecting two co-authors. If there are multiple co-authors an edge will connect all co-authors to each other. For example a paper with five authors will have five nodes and ten edges.

Distance is the minimal length between two distinct nodes (Travers et al. 1969). A distance is measured by counting the minimal number of edges it takes to traverse from one node to another node. Traversing edges can take into account the direction of the edge or not. In the current study directional edges are not used so to find the distance between two authors, you only need to minimal number of edges it takes to connect the two authors.

Connectivity is a notion of how an author (node) in the network is connected to others via an edge. Depending on the research question connectivity can be measured by the pure number of edges coming out of the node. The research may want to discover how a researcher is connected so a weight and distance measure to other nodes may be incorporated. Strength of edges and nodes may also be included in the measure. Connectivity may be shown on the network by proximity in the nodes. Using proximity measures can show how many authors are closely related to one author, or how many close authors are within a certain proximity (Albert et al. 2002; Barbasi et al. 1999; Barbasi et al. 2002; Henry et al. 2007; Vidgen et al. 2007). In the current study the connectivity is amount of edges that a node (author) has connected. This measure the amount of co-authorship that a particular author has. Keep in mind that an author that uses more co-authors will have more connectivity than one that single authors.

**METHODOLOGY**

The goal of this study is to find out how the social networks in IS are influencing researchers. In order to do this, we take a preliminary look at social networks apparent in publications. For the purpose of this paper co-author analysis was conducted at the journal level, and conference level. There were two journals analyzed. One the leading North American IS journal, and the other a leading French language IS Journal. These were Management Information Systems Quarterly (MISQ) and Systèmes d'Information et Management (SIM) respectively. The conference used was the Southern Association of Information Systems (SAIS) conference.

Data from the past five year period (2005 – 2009) was obtained using websites from each of the targets (MISQ 2009; SAIS 2010; SIM 2010). There were a few differences to note (Table 1). First the number of issues for MISQ were 21 due to a special issue in 2006 that was included in the study. SIM is also a quarterly journal but does not publish on particular months. SIM does not have their articles from the most recent six months, thus only two issues out of four were obtained from the 2009 year. SAIS is a yearly conference, so the number of issues were only five in the period studied. There seemed to be a limit on the number of articles published in the SIM as only four or five articles were published by SIM for each of the issues. MISQ and SAIS did not seem to adhere to a strict publication limit that seemed to exist with SIM.

<table>
<thead>
<tr>
<th></th>
<th>Start Date</th>
<th>End Date</th>
<th>No. of Issues</th>
<th>No. of Articles</th>
<th>Author Count</th>
<th>Author Count (no repeats)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MISQ</td>
<td>March 2005</td>
<td>December 2009</td>
<td>21</td>
<td>202</td>
<td>480</td>
<td>375</td>
</tr>
<tr>
<td>SIM</td>
<td>2005</td>
<td>Middle 2009</td>
<td>18</td>
<td>72</td>
<td>125</td>
<td>115</td>
</tr>
<tr>
<td>SAIS</td>
<td>March 2005</td>
<td>March 2009</td>
<td>5</td>
<td>209</td>
<td>434</td>
<td>323</td>
</tr>
</tbody>
</table>

Table 1. Venue Data
Author data from each article published were copied to a spreadsheet for analysis. Data needed cleansing, as formats were different from each of the websites. One interesting observation was that with the French SIM journal there was a lack of middle initial/name entries compared to the US counterparts. This was due to the cultural differentiation on the use of middle initial/names, and there was a definite difference in the use of a middle initial/name.

There were a total of 202 (MISQ), 72 (SIM), and 209 (SAIS) articles over the period. The raw count of the number of authors revealed 480 (MISQ), 125 (SIM), and 434 (SAIS) times that authorship appeared in the venues. When accounting for repeated authorship the counts lowered to 375 (MISQ), 115 (SIM), and 323 (SAIS) authors. This total number of non-repeating authors is the nodes of the social network.

There was minimal overlap of authors between each of the venues. Only fourteen authors appeared in two of the three venues. These fourteen researchers were: Hillol Bala, Richard Baskerville, Pamela Galluch, Geoffrey Hubona, Elena Karahanna, Richard Klein, Wolfgang Konig, Alan Lee, Kalle Lyytinen, Arun Rai, Michael Rosemann, Frantz Rowe, Jason Thatcher, and Viswanath Venkatesh. None appeared in all three venues. This points to the dichotomous nature of the IS field publishing circuit, not only between countries but also between differing venues.

**DATA ANALYSIS & RESULTS**

When looking at the authorship data articles with one, two, three, four, five, and six authors were identified (Table 2). One distinct difference that immediately stood out was the fact that the North American venues were similar in that the majority of papers were with two authors but there were also papers with larger amounts of authors including four, five, and even the existence of one article with six authors in each. The only glaring difference between the two North American venues were that single authored papers were rare in the case of MISQ, while more than double the amount of single author papers exist for SAIS. This may be due to the fact that the review process of MISQ is extremely rigorous, and taking on such a process on ones own may be much more challenging than working with others.

<table>
<thead>
<tr>
<th>Total Papers</th>
<th>Single Author</th>
<th>Double Author</th>
<th>Triple Author</th>
<th>Quadruple Author</th>
<th>Quintuple Author</th>
<th>Sextuple Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>MISQ 202</td>
<td>30 (14.9%)</td>
<td>97 (48.0%)</td>
<td>49 (24.3%)</td>
<td>20 (9.9%)</td>
<td>5 (2.5%)</td>
<td>1 (0.5%)</td>
</tr>
<tr>
<td>SIM 72</td>
<td>34 (47.2%)</td>
<td>23 (31.9%)</td>
<td>15 (20.8%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>SAIS 209</td>
<td>66 (31.6%)</td>
<td>79 (37.8%)</td>
<td>50 (23.9%)</td>
<td>11 (5.3%)</td>
<td>2 (1.0%)</td>
<td>1 (0.5%)</td>
</tr>
</tbody>
</table>

Table 2. Authorship Data: Number of Authors (Percentage of Total)

By contrast, for the French journal almost half of the articles (47.2%) were single authored. Also the number of articles with multiple authors plateaus at three for SIM as there are no papers with four or more authors during the five-year period. The difference here may be the publication culture as usage of multiple authors over three in the French IS journal seemed to just not be done.

<table>
<thead>
<tr>
<th>No. of Repeat</th>
<th>MISQ</th>
<th>SIM</th>
<th>SAIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td></td>
<td>3</td>
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<tr>
<td>4</td>
<td>4</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>49</td>
<td>6</td>
<td>33</td>
</tr>
<tr>
<td>Total Repeated Authors</td>
<td>66</td>
<td>6</td>
<td>60</td>
</tr>
</tbody>
</table>

Table 3. Authorship Data: Number of Repeated Authors

Another interesting find is that number of authors that are repeated in each venue (Table 3). Again we see a North America vs. France split here in that more repeats are prominent in MISQ and SAIS. While there are a number of authors that have
repeatedly published three or more times in MISQ (17) and SAIS (26), there are only six authors that have published two times in SIM and none have published three or more times in SIM over the last five years. An important note is that MISQ is the only venue of the three that has an editorial by the editor in chief (EIC). In creating Table 3 I did not counts these as articles so the past EIC, Carol Saunders did have 14, and the current EIC, Detmar Straub did have six publications in MISQ including editorials.

<table>
<thead>
<tr>
<th></th>
<th>Nodes</th>
<th>Edges</th>
<th>Most Connected</th>
</tr>
</thead>
<tbody>
<tr>
<td>MISQ</td>
<td>375</td>
<td>454</td>
<td>10</td>
</tr>
<tr>
<td>SIM</td>
<td>115</td>
<td>66</td>
<td>4</td>
</tr>
<tr>
<td>SAIS</td>
<td>323</td>
<td>330</td>
<td>13</td>
</tr>
</tbody>
</table>

Table 4. Social Network Stats

An important difference between MISQ and SAIS is that repeat publishing in MISQ is probably a difficult activity due to the rigorousness of MISQ publishing standards. Of the sixty repeat authors in SAIS, close to half (27 out of 60) have published three or more times. While for MISQ only 17 of the 66 (25.8%) have published three or more times. When put into a network the North American venues were more dense (Vlado 2010) than the French one (Figures 1 through 6. Figures were drawn using Pajek). The nodes represent the authors so the number of nodes (Table 4) is the same as the number of authors (Table 1). The number of edges represent a co-authorship. Due to the larger number of authors in the North American sample, one can see that the number of edges are larger for that sample. MISQ however is the most dense of the three (Figure 1 through 6).
FUTURE RESEARCH
Future research will expand upon the venues used, the increase in longitudinal data, and the extension to co-citation analysis. Venues will be expanded by adding more journals and conferences. The addition of more cross cultural research will expand the scope to a more global look at the IS field. One area that the current research did not touch upon was co-citation analysis. Citation analysis is prominent in analysis of the IS field and other fields in the business school. Expansion to co-citation analysis is currently underway.

CONTRIBUTIONS
By taking a SNA approach to the look at the IS field, this research has tried to identify the linkages between authors in IS. One problem identified by the research is that by looking at three differing venues, one a prominent North American journal, one a prominent French journal, and one a regional conference, we see that there is much opportunity to integrate the researchers that publish in these differing venues. The hope of this author is that more collaboration across these seemingly ‘cliquish’ groups will allow more dynamic and interesting research to flourish.

LIMITATIONS
By using a limited dataset the research only begins to scratch the surface of what the IS field looks like. The fact that only three venues were used is a weakness of the paper. Also the timeframe of five years, although good enough to give us a glimpse of the IS field, can be longer. SNA is also limited in that influence can be measured not just by co-authorship but can
include many other observations such as, and not limited to, citations, meetings, phone conversations, attendance at a conference, and working in the same location.

Another limitation of this study is in the data cleansing. Identification of identical names was a difficult and tedious process. Depending on the venue format, names may or may not include middle names, initials. First names may or may not appear as initials. Identification of these duplicates was left to the author and some errors are inevitable.

CONCLUSION
This research has attempted to use SNA to identify the researchers' social network in IS using three different venues. Three things have been highlighted by this research. One is the glaring difference that we see is the difference in publication strategy and co-authorship between North America and France. Second there seems to be even a difference between the two North American venues due to the difference in rigor placed in the publication process. Finally there seems to be a disconnect across the three venues as only fourteen researchers were identified as being published in two of the three venues and none were identified to have published in all three venues.

REFERENCES


TRANSCENDING IT MANAGEMENT TRADITIONS: TRANSFORMING FROM TECHNOLOGY-ORIENTED TO SERVICE-ORIENTED MANAGEMENT

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ABSTRACT
Large organizations establish departments for managing information technologies (IT) used to support their activities. Historically, this led to a view of the IT department as an important but costly technology-oriented department whose main activity was to keep things running. Recently, best practice has called for service-oriented management of IT departments. This report seeks to report from an organization's attempt to transform from technology- to service-oriented management. To structure the study we use Pettigrew's framework for understanding organizational change, emphasizing the content, the context, and the process of the transformation. IT management principles of technology- and service-orientation are considered as the content. The context is taken into account from an organization-centric analysis of structures, people, management practices, and technical structures. Finally, a punctuated process model that focused on event sequences of the transformation effort guided the process analysis. We use this contextual approach couched in an interpretive case study to understand the transformation to service-oriented IT management, and by so-doing, offer lessons for how managers can enact this change.

Keywords
Shared Services, IT Management, Service-orientation

INTRODUCTION
Managers of organizational information technology departments are continually faced with great challenges. As technology and business become more intertwined, a properly functioning business demands reliable IT. These circumstances are leading to new roles wherein enterprises are customers of IT departments (Mayerl et al. 2006). With this new customer focus IT departments are seeking to transform into service providers (Hochstein et al. 2005). While service-oriented frameworks have been developed, they are largely normative -- leaving managers with merely a set of best practices and no prescribed plan of action (Addy 2007). Consequently, executives need adapted management methods and knowledge of how to undergo such an evolution.

The purpose of this research is to explore how IT units in large bureaucratic professional organizations can transform from their historical technology-oriented management towards service-oriented management. To that end, we propose to investigate a transformation to service-oriented management using process theory principles (Van de Ven & Poole 2005). This will allow us to understand the process by which this transformation may occur.

The research investigation will be carried out over a 15-month period during 2009-2010 wherein we will study the transformation effort of an information technology department (referred herein as IT_Department) that provides services to a large university. The research site was selected both opportunistically and purposefully based on high-level access to the organization, and a belief that a longitudinal study of the transformation effort would make a significant contribution to research in this area. The stated goals of the transformation effort later confirmed this belief, and were aligned with service-oriented management definitions (Demirkan et al. 2008).

We will organize our study based on Pettigrew’s framework for studying organizational change, emphasizing the content, the context, and the process of transforming management styles at IT_Department (Pettigrew 1987, 1990b). This framework is ideal as it supports longitudinal investigations of how transformation efforts unfold in organizational settings. Interactions among the three areas of the transformation (content, context, and process) are used to gain insight and understanding, and are then used as a basis for managing change under similar conditions in other organizations.

We present the compositional elements of our research to enhance clarity in Table 1. These elements consist of area-of-concern under investigation (A), conceptual framing of the investigation (F), method of investigation (M), research question (RQ) and contributions to practice and theory (C and CFI) (Mathiassen et al. 2009). These core structural elements appear in more detail in the in this document.
Olsen Transcending IT Management Traditions: Transforming to Shared Services

Proceedings of the Southern Association for Information Systems Conference, Atlanta, GA, USA March 26th-27th, 2010

| Area of Concern (A): Management of IT departments in large professional bureaucracies (Mintzberg 1983) |
| Framing independent of A (FI): An organization-centric analysis of the organization during transformation based on Applegate’s change framework (Applegate 1994) |
| Research Method (M): Qualitative, single case study, with retrospective and real-time longitudinal analysis (Leonard-Barton 1990), using ethnographic data collection methods, and rooted in interpretivism |
| Contribution to A (C): An explanatory, descriptive account of the process undertaken by IT_Department to transform to service-oriented management |
| Contribution to FI (CFI): Normative service orientation transformation process model grounded in the case as well as literature about service management |
| Research Question (RQ): How do IT departments in large professional bureaucracies transform from technology- to service-oriented management? |

Table 1. Compositional Elements of Research

In Section 2 we provide a review of the literature for the content of technology- and service-oriented IT management. Section 3 focuses on describing the framework that will be used to interpret the organizational context. The method for presenting a description of the transformation process is put forth in Section 4. Section 5 discusses our research method, and data analysis techniques. Finally, Section 6 outlines the expected results of our study, while Section 7 discusses potential research contribution to both theory and practice.

CONTENT: SERVICE-ORIENTED IT MANAGEMENT

Service-oriented management is all about delivering value added services to the customer (Demirkan et al. 2008, Mayerl et al. 2006). Customer expectations of customized solutions, dynamically changing markets, regulations and technologies, have lead to increased needs for companies to be able to transform from a focus on goods to a focus on services (Christensen and Raynor 2003, Vargo and Lusch 2004). Although the benefits of the adoption of such practices are numerous, the service concept has been and still is difficult for established managers to grasp (Magnusson and Stratton 2000). The service paradigm has dramatic implications for technology and management (see Table 2).

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus on goods</td>
<td>Focus on services</td>
</tr>
<tr>
<td>Cost reduction through manufacturing efficiency</td>
<td>Revenue expansion through services</td>
</tr>
<tr>
<td>Standardization</td>
<td>Customization</td>
</tr>
<tr>
<td>Mass marketing</td>
<td>One-on-one marketing</td>
</tr>
<tr>
<td>Transactions</td>
<td>Relationships</td>
</tr>
<tr>
<td>Function oriented</td>
<td>Coordination oriented</td>
</tr>
<tr>
<td>Limited ability to store and process data</td>
<td>Improved ability to store and process data</td>
</tr>
<tr>
<td>Limited information sharing capabilities</td>
<td>Improved information sharing capabilities</td>
</tr>
<tr>
<td>Application silos</td>
<td>Integrated solutions</td>
</tr>
<tr>
<td>Tightly coupled applications</td>
<td>Loosely coupled solutions</td>
</tr>
<tr>
<td>Contracts</td>
<td>Service-level agreements</td>
</tr>
</tbody>
</table>

Table 2. Categories of transformation towards service-oriented management (Demirkan et al. 2008)

Service orienting requires much more than a change in organizational structure. Siloed businesses processes must be broken into modular independent services that can be used in loosely coupled dynamic business services (Demirkan and Goul 2008). Staff must be taught how to involve customers in service design and delivery. Likewise, organizational incentive mechanisms need to be changed to encourage this collaboration (Keel et al. 2007). Organizational metrics should reflect the success of the organization in supplying services to customers. All of these differences entail a major culture change that will require strong top-down and bottom-up organizational support, and time to implement (Demirkan et al. 2008).

PROCESS: PUNCTUATED SOCIO-TECHNICAL ORGANIZATIONAL CHANGE MODEL

Following prior work (Newman & Zhao 2008) we outline our approach to conduct a process analysis of a transformation to service-oriented management.
Process and Variance models

Mohr describes the process and variance research approaches for studying organizational change (Mohr 1982). Since Markus and Robey (1988) introduced Mohr’s process approach, and it has been used to describe many IS phenomena including project management (Montealegre and Keil 2000) and service provisioning (Crowston 2000).

The limitations of variance models highlight the virtue of process models as Newman and Robey (1992) point out: “factor models...do not explain how outcomes occur... they provide only partial guidance to the practitioner who must assume responsibility for attaining positive outcomes. The attainment of system success can be likened to a puzzle wherein the pieces can be identified but where the implementer is left to his or her own resources to put the puzzle together. The process approach... focus on the dynamics of social change, explaining how and why the results...are achieved”. The process approach seems to provide better solutions to address the nature of our research question. For purposes of this research, we define the meaning of process to be “a narrative describing how things develop and change” (Van de Ven & Poole 2005).

Punctuated Socio-Technical Organizational Change Model

Based on Newman and Robey (1992), Newman and Lyytinen (2008), and Applegate (1994) this study is constructed on three major frameworks: Applegate’s organizational system change model; a social process model; and a punctuated equilibrium model. Applegate’s organizational change model is used to identify the relationships between structure, people, and management and technical systems and their effects on the management transformation. This is similar to Leavitt’s (1965) socio-technical change model which has been used to explain IS change, but Applegate’s framework was adapted to deal with nuances dealing with the organizational aspects of information technology (Applegate 1994).

The social process model is applied to describe outcomes to the transformation process (Michael Newman and Robey 1992) where organizational change is seen as a construction of a sequence of incremental changes and critical incidents representing periods of equilibrium and disequilibrium within organizational and external contexts (Gersick 1991; Lyytinen & Newman 2008; Pettigrew 1990b). Finally, punctuated equilibrium theory is used to understand how change occurs. IT Management transformation is depicted as having relatively long, stable periods, punctuated with opportunities for change to the deep structure (e.g. a crisis such as a change in leadership or major issues arising from organizational structures that lead to a radical change of approach).

A gap can invite two types of responses from the organizational system. The first is an incremental and gradual adaptation of system components as dictated by the organizational systems deep structure. The deep structure consists of the set of fundamental ‘choices’ an organization system has made concerning “1) the parts of which its units will be organized, and 2) the activity patterns and principles of interaction that will maintain its existence” (Gersick 1991). Deep structures are stable, based on historical patterns, and manifest path dependency (Garud and Karnøe 2001). Actors who recognize a gap may construct an intervention (e.g. small group training) to try to remove it. Also included in this example are the elements of organizational (inner) and external (outer) contexts (Pettigrew 1990a) as these may affect critical incidents. In these interventions, the deep structure of the process remains intact (Gersick 1991).

The second type of response is a punctuation -- where actors re-examine and change fundamental assumptions about how work is accomplished or how the organization is structured, thus rewriting the organizational systems deep structure. During punctuation, organizational system elements are re-configured and afterwards they exhibit new emergent properties. These types of changes are infrequent. The start of a transformation effort nearly always involves punctuations, first in the build system where the effort is initiated and later when it replaces the prior structure (Newman & Zhu 2009).

In summary, shaped by a historical context, existing structures remain in place until a critical incident (planned or unplanned) produces a gap, resulting in an unstable organizational structure. Actors may recognize this unstable state and attempt to implement interventions to address these gaps. The deep structure of the organizational system remains unchanged, unless punctuations occur.

Combining all these process frameworks, Lyytinen and Newman (2008) will build what Langley (1999) calls a visual mapping strategy, depicting dependencies between environments, events and outcomes by organizing them according to sequence, gaps, system levels, punctuations, and interventions. Organizing the events of the transformation process in this way creates a sense-making device we can use to understand the nature and role of different events in the context of transforming to service-orientation. As an example of one of the outcomes of our proposed research project we include a plausible (not based on data analysis) visual map of the transformation process. See figure 1 as an example

The visual map shows the work system, the building system, and a description of critical incidents, events in the context of the organization and its environment. It is designed to build an accurate process narrative about a situated transformation effort that can later be generalized (Eisenhardt 1989).
RESEARCH APPROACH

This study adopts a qualitative research approach with the support of a longitudinal interpretive case study of IT department in a large public university.

Research Site

IT_Department is an information technology department that provides IT services and support to a large University in the United States. In 2009, this department employed approximately 200 personnel. In the past, management attempted to implement service management principles from well-known service-management frameworks with poor success. A recent strategic effort in which they have analyzed the cost of providing services has caused them to initiate an effort to adopt service-oriented management principles. The department enlisted the help of an outside consultant who provided the framework for and expertise in the management of such a transformation. The consultant had experience working with many IT departments who had also had poor success and university IT departments that are undertaking similar “service” transformations. The department had been working with the consultant for 5 months on the design of the new organizational structure when we entered the field.

Data Collection

Our in field research efforts will occur over a 15 month period (2009-2010). Although we are not conducting and ethnography, we collect data according to an “ethnographic field study” approach (Levina 2005). Typical ethnographies are focused on understanding culture (Van Maanen 1988). Ethnographic field studies use similar methods, but focus on understanding something (i.e. a transformation) in situ (Levina 2005). The majority of our data consists of intranet postings, photos, emails, excel documents, meetings observations, informal “hallway conversations”, and interviews.

Meeting observations

Longitudinal real-time meeting observations will be conducted during monthly and weekly steering committee meetings, which consist of the entirety of the upper level management. In these meetings management teams are taught principles of service-oriented management, discuss how to implement new service requests from customers, plan transformative actions, and discuss problems they encounter along the way. These meetings will be recorded with the consent of those present and personal notes and the researcher will record reflections from the field later that same day (Barley 1996). Pictures of the meetings will be taken for the sole purpose of aiding the researchers’ memory of the events and ambient factors surrounding the event.

Data Analysis

Each interview and meeting transcript or set of notes taken from document analysis, observations, and informal “hallway interviews” will be coded using qualitative analysis software. Changes to organizational dimensions will be coded based on Applegate’s (1994) framework. Critical incidents resulting in gaps will be coded with Atlas.ti according to the pre-established methods discussed in Section 4 and the six-step process discussed below (Gersick 1991; Lyytinen & Newman 2008).

In step one, data transcripts are used to produce a basic narrative of the overall process: what happened; when did it happen; what went before; what were the outcomes; and what were the influences? These features will be found using a microscopic approach (Strauss and Corbin 1998) which consists of line-by-line coding of the data. During this step, the antecedent conditions will also be identified. From this analysis we will attempt to identify the events, episodes, and stages related to the transformation. In the second step we will look for critical incidents, separating them out into work and build level events, while looking for interactions between them. Step three uses the punctuated equilibrium model (Gersick 1991) to analyze these critical incidents. This model describes change as relatively stable (evolutionary) periods that are punctuated by shorter, turbulent (revolutionary) periods (often started by critical incidents). Fourth, we will interpret the data to draw individual organization-centric diagrams, identifying the four components of Applegate’s (1994) model and any gaps in between them. As there are no clear-cut boundaries between the four components, we will rely on our interpretations to make these categorizations (Newman & Zhu 2009). In the fifth step, we will analyze the context of the organization, university, and broader economic context for their interactions with the process. Finally, we will combine data from steps one to five to construct the overall process diagram (see Figure 1 as a possible example of a research outcome). These steps are seen as a simplification of a process that in reality includes much iteration.
Upon conclusion of the analysis a “member check” will be conducted, wherein all of the final research report’s findings are presented to interested members of the community to solicit their comments. The insights gained from this process will be incorporated into the research report.

**DISCUSSION**

This research will produce several contributions which will be of interest to the IS community. First, we will demonstrate the advantages of using a punctuated process model to describe the organizational transformation that enables service-oriented management. The use of gap analysis, and build and work processes will yield an insightful and descriptive process description. Second, our study will be able to provide insights into the patterns that lead to success or failure in transforming to service-oriented management. These insights will be a boon to many practitioners of IT management. Third, as there is a dearth of this type of labor-intensive process study (Newman & Zhu 2009), this research will serve as a model to others considering a similar research paradigm. Fourth, we will build much needed theory in this nascent area of service-oriented management (Demirkan & Goul 2008).

**REFERENCES**


CONCEPTUALIZING THE IT ARTIFACT: A NON-REFLEXIVE ACTOR

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ABSTRACT
Orlikowski and Iacono (2001) issued a call for improved conceptualization of the IT artifact. This paper has responded to that call. After a review of three approaches to conceptualization of the IT artifact, it articulates a conception of the IT artifact as a non-reflexive actor. Based on Archer’s analytical dualist approach to social theory, it argues that IT artifacts need to be considered as actors, able to act independently of humans based on environmental characteristics to perform different tasks. They are non-reflexive in that they cannot consider their own actions and change their behavior. This conception has certain implications in how we approach artifacts. We to consider them as actors which certain skills and abilities and communication characteristics to bring to our business processes. For research purposes, we have to take a more sociological or anthropological approach to the study of these actors. For practical purposes, we need to build approaches analogical to those of human hiring practices to determine where and how to employ these actors.

Keywords
IT artifact, Structuration Theory, Actor-Network Theory, Knowledge Management, Analytical Dualism

INTRODUCTION
Orlikowski and Iacono (2001) have made an appeal for a conceptualization of the IT artifact. In their study of ISR articles, they found that IS research “draws on commonplace and received notions of technology, resulting in conceptualizations of IT artifacts as relatively stable, discrete, independent, and fixed.” (p. 121) They further argued that this lack of a conceptualization of the IT artifact presents a “unique opportunity and … challenge to engage seriously and explicitly with the material and cultural presence of the IT artifacts that constitute the IT in IT research.” (p. 130) This paper attempts to respond to their call and address specifically how the IT artifact should be conceptualized in social situations.

The paper will proceed by a brief review of some of the pertinent literature bearing on how the IT artifact may be conceptualized. It then proposes an alternative conceptualization.

BACKGROUND
In this section, I survey some of the literature bearing on this topic and give some examples of how IT artifacts appear within social situations. In doing so, I will attempt to relate those observations to what Orlikowski and Iacono (2001) have proposed as the necessary considerations for IT artifact theorizing:

1. IT artifacts, “are by definition are not natural, neutral, universal or given … they are always implicated in action and effect.” (p. 131) We need to have “explicit theorizing about specific technologies with distinctive cultural and computational capabilities, existing in various social, historical, and institutional contexts, understood in particular ways, and used for certain activities.” (p. 131) This theorizing will not allow a one-size-fits-all conceptualization; multiple conceptions and theories about technology as it exists.

2. IT artifacts “are always embedded in some time, place, discourse and community.” (p.131) “Detailed practices need to be recognized and integrated into theories. … How people engage with [them] … needs to be a central [part of the theorizing].” (p. 132)

3. IT artifacts “are usually made up of a multiplicity of often fragile and fragmentary components whose interconnections are often partial and provisional and which require bridging, integration, and articulation in order for them to work together.” (p. 131) The material and cultural properties of an artifact are not the same in all contexts meaning experience will vary.

4. IT artifacts “are neither fixed nor independent but they emerge from ongoing social and economic practices.” (p. 131)

5. IT artifacts “are not static or unchanging but dynamic.” (p. 131)

Knowledge Management Perspective
In the knowledge management literature, (Kogut et al. 1992) have observed: “Because personal and small group knowledge is expensive to re-create, firms may desire to codify and simplify such knowledge as to be accessible to the wider
organization, as well as to external users. ... The reason why software has been successful is that it is codified so as to
demand a lower fixed cost on the part of the general user. The user is required to understand the function of the program
without knowledge of the substantive technology (p. 390).” The implication of above observation is that in such cases as
described by Kogut and Zander, the information system (software) replaces the human performance in a substantial part of
the task for the business process, while the human, instead of performing the details of the process itself, addresses the
system at a higher (functional) level allowing the information system to execute the detailed activity. We can see from this
that the IT artifact is embedded in some practice within the society. The specific meaning of the artifact is based on how the
process that surrounds the artifact relates to or incorporates the artifact. However this view does not conceptualize how the
artifact replaces human actors or what its capabilities are.

**Actor-Network Theory**

Actor-Network Theory (ANT), developed by Bruno Latour (1987; 1993; 1999), Michel Callon, John Law and others has
been advocated in the IS literature by Monteiro, Hanseth, McMaster, and Wastell and others, ANT offers a novel social
ontology that refuses an essential difference as actors between humans and non-humans. “There is no room for essences . . .(a
prior a historical properties that capture the intrinsic nature of the phenomenon or entity . . .)” (McMaster et al. 2005).
Instead, ANT argues that all actors are actually networks of actants that it refers to as “collectifs”. Both humans and non-
humans form these collectifs as equals. There is no distinction between macro and micro or local and global as it is
traditionally considered (Mutch 2002). The modern world is so pervasively fabricated, tools and technology so ubiquitous,
that we simply cannot meaningfully separate humans and non-humans. The symbiosis is mutually critical; literally neither
can exist without the other. “The place where a person and a tool exist independently is a distinction for convenience’s sale,
not a functional one. Where does the person hammering in a nail exist independently from the hammer? (Dreyfus 2004)”
(McMaster et al. 2005).

This is not to say that there is no difference between humans and machines in ANT. Humans and technologies (in the
traditional sense) are not equal or symmetrical beyond the fact that they are, when they act, parts of hybrid collectif that
should be seen as the ‘real’ actor: Humans and technologies are different – as different humans (the CEO and truck driver in
a multinational organization) and different technologies (a pen a nuclear plant) are different. (Hanseth 2005).

In terms of the analysis of agency with ANT, the collectif represents the ultimate actors in social life. “Boeing 747s do not
fly, airlines fly” (Latour, 1999, p. 193). It is hybrid actants composed of humans and non-humans that act; the act and the
actants cannot be separated (McMaster et al. 2005). Thus the human qua human or machine qua machine do not “act” except
as it is part of a collectif. Thus social forms are the outcome of these networks rather than the condition of their existence.
Mutch (2002) “All actants have a history, and it only through their action in the world that they have an identity. . . . An ERP
without agency is an ERP that, by definition, does not exist. By their deeds yet shall know them (McMaster et al. 2005)”.

Here the artifact is also embedded in the network, but it is not the proper level of analysis. The collectif to which it belongs is
the proper level of analysis here. This makes it rather difficult to assess the impact of the artifact as it is entangled with the
collectif. Thus this view can be considered as obliterating the artifact by absorbing it into the collectif.

**Structuration Theory**

Structuration Theory (ST), derived from Giddens (1979; 1984) and popularized into the information systems literature by
Barley (1986) and Orlikowski (1992; 1993; 1996; 1991), views social structures as not being real things, they are viewed as
“virtual” structures composed of rules and resources. They are “... abstract properties of social systems . . . not something
concrete, situated in time and space, ... [they] lack material characteristics . . . [they] cannot exist apart from the human
actors who enact and interpret its dimension” (Orlikowski et al. 1991, p. 147). Thus structures exist only due to “this people
now acting.” Where there are no people now acting they cannot exist. According to ST, past actors cannot create structures
that persist into the present time without being carried forward by current actors. They could only be “memory traces” when
not “instantiated” by current actors. (Jones et al. 2004).

Orlikowski recognizes that Giddens has done little to bring information technology into ST (Orlikowski 1992; 1999
Orlikowski 1992; Orlikowski 2000; Orlikowski et al. 1991). She posits that it is a duality being created by humans and also used by humans and that it is
interpretively flexible (Orlikowski 1992). Technology facilitates, constrains and influences human action in the process of
structuration. Information technology is seen as a way of representing reality that influences the users to adopt the same
interpretation of the world. Additionally, it is a system of domination in that it reinforces an order of authority and
institutionalizes premises for making decisions. It thus formalizes the sanctions and creates an institutionalized moral order
(Orlikowski et al. 1991). Orlikowski has changed her position on this last point, coming to purer form of Giddens’ theory
rejecting the view that technology embodies structures since structures are only instantiated in practice (Orlikowski 2000).
She argues instead that technology, while being a durable artifact with limited malleability, is enacted by its users as a

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technology-in-practice. That is, over recurrent use, the users develop a perspective of the technology based on their experience with a subset of its capabilities. This perspective is then enacted into structures in ways that the developers may or may not have anticipated. These technologies-in-practice and the structures created change over time and thus any structure enacted by users is only provisionally structured (Orlikowski 2000).

The handling of technology within ST has received some criticism. Rose, Jones and Truex (2005) claim that even with Orlikowski practice lens enhancement, ST unduly privileges human agency which causes technology to vanish into being simply “an occasion for structuring”. Similarly, Hanseth (2005) claims that Orlikowski’s technology-in-practice formulation does not allow for any description of the relationship between the technology-in-practice and the technology artifact and how they mutually influence each other. As dealt with in Orlikowski (2000), information technology is held to be a non-actor. It is treated as a multi-faceted too from which users select features to be employed in structuring the organizations. In Orlikowski (2005), she seems to recognize this and advocates that we look at “different conceptual treatments of human and technological agencies” (p. 185). She recognizes a difference between human and technological agency preferring to call the later “technological performativity”.

Thus in looking at these three approaches, we see that the knowledge management view acknowledges the artifact as a replacement for human actors but does not conceptualize how it does it. ANT seems to level humans and artifacts making both of them cogs in the mechanism of the collectif, but again not articulating how they can participate equally with humans. Finally, ST has a much lower view of the artifact as a non-actor which seemingly cannot explain how the artifact can replace humans in business processes as described the knowledge management approach.

PROPOSING A DIFFERENT CONCEPTUALIZATION

A different conceptualization can be arrived at the might be able to resolve these issues and help us to arrive at a conceptualization of the IT artifact. To facilitate this discussion consider four different ways that an IT artifact may interact with a business process.

First, an IT artifact may operate substantially all of a business process. Consider a claims processing system. The author was involved with EDS in the 70s working with Medicare claims processing systems and in his doctoral research with Medicaid process in the 2000s. In these systems, the claim is substantially processed by the system. Humans enter the claim data, the system processes the data and produces an explanation of benefits. The system handles the claims by itself except when human adjudication of a situation is required.

Second, an artifact may co-operate a process with humans. Consider MS Word. In entering a document, the human enters the letters and images desired, while Word provides formatting services, spell and grammar check etc. In fact in many of these functions Word operates to overrule the human operator: correcting spelling, inserting outline levels even if contrary to the wishes of the operator. Each operates independently of each other to create the document.

Other artifacts enable a process for human operators. For example, Broadbent (1999) found that email and other electronic communications methods were necessary enablers to achieving enterprise-wide BPR. In this scenario, email enables BPR by providing the ability to communicate instructions and information over distances in time factors not possible using physical communications such as letters. Here the artifact does not perform any of the process but enables the human actors to execute the process.

Finally, an artifact may simply monitor a process. In the example of a manufacturing plant monitoring system, the artifact my extract data on machine production from programmable controllers and then perform statistical analysis and sound alarms to humans who take corrective action. Or the artifact may provide reporting on production volumes and machine status.

Depending on the implementation of the artifact in the process, the same artifact in a similar process might in one case operate the process but in another might only co-operate the process. The key consideration is how much of the particular process is handled by the IT artifact. In the operate situation the artifact handles close to 100% of the substantive operations of the process. In the claims processing example, simply entering the data and assisting with exceptions is not the substantive part of the process, which is performed by the artifact. In the co-operate designation, there is close to an equal division of the substantive parts of the process. In the example of MS Word, while the user enters the text into the system and thus it seems similar to that of the claims processing system, which operates the process. However, when using MS Word, the user is not merely keying data in, they are making a substantive contribution to the process: the creative aspect of what is written. Word operates as an assistant. In terms of the enabling function, the artifact would not perform much of the process, but would provide a necessary part of the process, e.g. information transportation, storage and retrieval that makes the process possible. In the last consideration, monitoring, the artifact does not operate or provide enabling capabilities but rather simply collects data and reports on the process.
A key observation from each of these examples is that the artifact acts independently of humans to perform the function assigned to it by the human creators of the process. To be sure, Orlikowski and Iacono are quite right in informing us that each of these artifacts are very different from each other with different characteristics that prevent us from saying that the effects of employing one are the same as the effects of employing another. And indeed even the use of the same artifact in different organizations will have different impacts. However, there is a commonality between them that allows us to conceptualize the IT artifact in its interaction with humans. I term this relationship one of being a non-reflexive actor.

By the term, non-reflexive actor, I mean an entity that interacts with humans in the business process. By non-reflexive, I mean that unlike humans, IT artifacts are not capable of reflecting on their actions, conceiving action and changing their process. It remains for humans to perform this function. Perhaps as artificial intelligence develops, this capability may develop in which case the artifact will become a full actor like a human. But as of this writing, artifacts do not have that capability. Today, we have some artifacts that have some capability for changing their behavior. Examples might be drawn from commercial websites such as Pandora, Netflix, Amazon or iTunes which utilize the customer’s interaction to make recommendations for future purchases. These are not examples of reflexivity. In these cases, we see that these sites are simply executing programmatic instructions that make recommendations. The software does not consider its actions and for example, consider that it has information on purchases and decide it would be a good thing to make recommendations. It can only follow its programming. It requires the ability to change or add to its programming to become reflexive.

To fully develop how IT artifacts can be actors, I extend Margaret Archer (1995)’s Morphogenetic Approach to Analytical Dualism. Below, I briefly describe her approach to agents and actors and then extend her conceptions for IT artifacts.

Archer’s Requirements for Agents and Actors

Archer holds that Agents and Actors are two different things. Actors are role incumbents. They occupy a particular place in society. Agents become Actors by choosing to identify themselves with a particular role within a society. Agents are born into a social order, which provides incentives and enablement for adopting certain roles and disincentives and barriers for pursuing others. Over time, Agents either are able to transcend society’s structuring forces and achieve something different for themselves or else adopt the role that societies structuring forces seek to have them adopt. Agents acting together can become Social agencies, which can then affect social change.

Agents however have certain requirements. Following Locke, Archer (1995) seems to define personhood as “a thinking intelligent being, that has reason and reflection, and can consider itself as itself, the same thinking thing in different times and places.” (p. 282, note 23, citing Locke, Essay II, xxvii, 2). She puts considerable emphasis on a continuity of consciousness and sense of self as definers of human personhood. We wish to add to this sentence, the characteristic of reflexivity: the capability of reflecting upon itself and its actions. It is reflexivity that creates the capability for morphogenetic action. Through the human characteristics of imagination, sentience and continuity of consciousness, humans are able to consider their condition and envision actions that would effect changes in it to improve their situation. Included in the concept of reflexivity is the concept of initiative. Humans have the capability to take unilateral action to attempt to implement their visions. Similarly included is the concept of decision-making. Humans can decide between alternative visions based on various criteria. Without these characteristics, morphogenesis is impossible.

A Typology of Technological Actors

When considering non-human or technological actors, we have to consider in what ways they differ from humans. We saw above that reflexivity and its two component parts, initiative and decision is key to morphogenetic activity. We propose that these three characteristics that differentiate actors. What follows below is a description of two types of non-human actors based on different levels of these characteristics.

Tools

Tools are non-reflexive, non-decisive, non-initiatory items. They are not actors since they are capable of only performing deterministic processes at the initiation of an actor. Classical examples would be a hammer or a chain saw. Both do not initiate action, it requires a human to start them and use them to accomplish a purpose. They also respond to all situations with a single action whether they are accomplishing the intention of a human such as a hammer hitting a nail or an accident such as a hammer hitting a thumb. They do not reflect on their actions and change their actions accordingly. It requires a human to consider their performance and then to effect change in their structure based on the desired performance changes.

Non-reflexive actors

Non-reflexive actors make decisions and can initiate actions based on environmental conditions but are not capable of changing their processes autonomously. They receive a set of environment signals, evaluate them and then make a decision based on pre-programmed criteria. Simple examples of these actors include burglar alarms and automatic shedders. A burglar...
alarm may for example have open window/door sensors or room motion sensors and when the alarm is set, given the proper amount of opening of a door or window opening or motion in a room, an alarm is sounded. Similarly, a shredder when it determines that paper is in contact with its feed mechanism activates its shredding mechanism. No human action is required for it to do so; it evaluates the environmental conditions and initiates the appropriate action.

Information systems are more sophisticated examples of these types of actors. A hypothetical health care claim processing system might receive a claim electronically from a doctor’s office. It might then evaluate the claim according to pre-programmed rules to determine if all the fields on the claim are completed correctly, the claim is not a duplicate claim, is not an excessive charge for the services performed, the service is appropriate for the diagnosis, etc. It may then determine, again based on pre-programmed rules, to pay the claim, cut back the amount to a reasonable charge, deny the claim or refer it for human review. We see that it initiates processing based on presentation of a claim, then without human intervention processes the claim and decides based on pre-programmed criteria the disposition of the claim. It is not reflexive in that it is not self-aware and cannot change its programming. Humans are required to perform this function.

It might be objected that neural networks are reflexive since they are capable of changing their responses to environmental stimuli but only within limits such as changing some of its decision criteria but it cannot changes its inputs or outputs. It is also not self-aware and cannot consider a radical change beyond its programming. Thus they cannot be considered reflexive.

It might also be objected that I anthropomorphize information systems by describing them as evaluating situations and taking action. Information systems are simply (or not so simply) collections of circuits and wires that no more ‘evaluate’ or ‘decide’ than a mousetrap ‘decides’ to spring based on pressure on the trap. I answer that the definition of an actor does not require reflexivity; it simply requires the ability to respond to environmental conditions independently of another actor. This ability to respond is what determines an actor whether or not it is a mousetrap, a ‘Rube Goldberg contraption’, a medicare claims processing system or a human. It is reflexivity that separates humans from the other actors mentioned.

This distinction points to another. Non-reflexive actors are non-social actors. That is, they cannot participate in business process structuring activity. This is a function that only reflexive actors can perform. IT artifacts will always be passive in this type of activity.

DISCUSSION

The conceptualization of IT artifacts as non-reflexive actors has certain implications. First is that we can no longer consider artifacts as simply “bundles of affordances” that do not have a social impact nor can we consider them to be equal with human actors. Rather we must treat them as actors who can fill roles within a social setting but rather limited ones not requiring learning capability. For placement in our processes, we must assess their capabilities and strengths in a manner analogous to that of assessing a human for a position. I say analogous because we cannot use exactly the same processes that we do with humans although some might be quite similar. For example, references and testing might be very similar. However, interviewing might look quite different.

Consideration of artifacts as non-reflexive actors also points out that these systems bring rigidities to the business process. Whereas humans can adjust independently to novel situations, artifacts cannot. Therefore, depending on the difficulty of implementation, once implemented, the skills and abilities of the artifact along with its communication capabilities can disable an organization from moving in certain directions as much as it enables it to function in others.

In terms of Orlikowski and Iacono’s five criteria, we can make the following observation of how this conceptualization of IT artifacts aligns. In regards to the first criteria, we see that by giving them actor status, that they are always implicated in the action and effect of a business process. The capabilities of the actor impact the human actors around them for good or ill. Each artifact having different capabilities and each organization also have capabilities from other organizations will create a unique environment. Therefore, even with the same artifact, we cannot generalize it having the same impact in different organizations. Second, we can see that just as human is embedded in a context, the non-reflexive actor is embedded in a context. As seen before they interact with the organization into which it is placed and different organizations will make different uses of this actor just as the same person will have different employments in different organizations. In terms of the third principle, this conceptualization differs with Orlikowski and Iacono’s perspective slightly. Their perception is like that of ST. An artifact is not socially “real” until it is used and then only that part of it being used is real. As a non-reflexive actor, it is held to be a real thing with a defined set of skills and abilities and communications patterns. While different organizations might make different use of them, the material properties remain the same in all places. In terms of the fourth and fifth criteria, this is the area of the greatest divergence from their views. We see that as non-reflexive artifacts, they are fixed and independent of the people around them. Orlikowski and Iacono’s view seems to be based on a social construction of reality position, which does not allow for the reality of the artifact has having a material impact. However, I take a realist position regarding the artifact. It is what it is, humans make take advantage or not of the different capabilities just as they
would a human. Left to themselves they do not change. It is required for humans to change them. Now this process is a social and indeed a political process in which the artifact itself is the end result of a negotiated process in which power plays a role.

CONCLUSION
This paper has articulated a conception of the IT artifact as a non-reflexive actor. Based on Archer’s analytical dualist approach to social theory, it argues that IT artifacts need to be considered as actors, able to act independently of humans based on environmental characteristics to perform different tasks. They are non-reflexive in that they cannot consider their own actions and change their behavior. This conception has certain implications in how we approach artifacts. We need to consider them as actors which certain skills and abilities and communication characteristics to bring to our business processes. For research purposes, we have to take a more sociological or anthropological approach to the study of these actors. For practical purposes, we need to build approaches analogical to those of human hiring practices to determine where and how to employ these actors.

REFERENCES
MEASURING INFORMATION SYSTEMS AGILITY: CONSTRUCT DEFINITION AND SCALE DEVELOPMENT

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ABSTRACT
Organizational agility has been a touted by both researchers and practitioners as a key success factor in navigating turbulent business environments. With a heavy reliance on computer systems by many organizations, information systems agility has become an important contributor to organizational agility. The purpose of this paper is to investigate previous attempts at defining the IS agility construct and synthesize the previous work into a single, comprehensive definition of IS agility. With a complete definition of IS agility compiled, steps will be outlined for developing a reliable scale for measuring IS agility within organizations.

Keywords
Information systems agility, IS architecture, IS personnel, IS processes

INTRODUCTION
The ever-changing business environment requires organizations to react quickly and easily to business challenges that arise. The terms agility, flexibility, and dynamic capabilities have all been used to describe this phenomenon and researchers have approached the topic from numerous viewpoints. Specific to information systems literature, agility has been studied as an independent variable (Sambamurthy, Bharadwaj and Grover, 2003; Gebauer & Schober, 2006), a dependent variable (Fink & Neumann, 1997; Wang, Ju, Jiang and Klein, 2008), or in an exploratory manner (Byrd & Turner, 2000; Duncan, 1995). Most of the previous literature focuses on individual components of IS agility and does not attempt to capture the full domain of the construct. Additionally, there does not appear to be a widely utilized measurement tool for evaluating IS agility within organizations.

This paper aims to address these issues by providing several contributions. First a review of the previous literature will be presented. By synthesizing concepts from previous studies, a holistic view of IS agility will be formed and the multi-dimensional construct of IS agility will be defined. Finally, a scale will be developed to measure IS agility within organizations.

BACKGROUND OF THE IS AGILITY CONSTRUCT
After a thorough review of previous literature, it was determined that research has focused on three primary dimensions of IS agility: agility of the IT artifact, of the processes supporting the IT artifact, and of the people involved in the processes.

When investigating the agility of the IT artifact, a clear focus on the architecture and infrastructure is necessary. Studies have defined this infrastructure as a set of shared, tangible IT resources that form a foundation to enable present and future business applications (Duncan, 1995) or as “the ability of the IT unit to provide extensive firm-wide IT infrastructure services that support the organization's business IS processes” (Fink & Neumann, 2007). Broadbent, Weill and Neo (1999) list hardware platforms, base software platforms, communications technology, middleware and other capability that provides shared services to a range of applications and common handling mechanisms for different data types as the key components to technical infrastructure. Weill, Subramani and Broadbent (2002) describe channel management, security and risk management, communications, data management, application infrastructure, and IT facilities management as key components to the infrastructure. Other studies zero in on individual components of technical infrastructure such as application architecture (Allen & Boynton, 1991), software characteristics (Gebauer & Schober, 2006), or the connectivity of IT components (Sambamurthy et al., 2003). Collectively, this dimension of agility will herein be referred to as “technical infrastructure agility”.

The processes by which information systems are supported and changed also represent a key component to IS agility. There is a direct linkage between IS processes in place and the technical infrastructure capabilities of the organization (Fink & Neumann, 2007). Goodhue, Chen, Boudreau, Davis and Cochran (2009) identify the processes by which organizations apply changes to their ERP and non-ERP systems to achieve agility. Other studies have investigated the impact of change management procedures and management review of IS development processes on the flexibility of an IS (Wang et al., 2008) and defined the importance of IT management services and IT architecture and standards services in providing a set of
processes by which IS agility can be attained (Weill et al., 2002). We combine this previous work into the “IS process
gility” dimension of agility in this paper.

Although some studies do not specifically focus on the human characteristics that influence agility, it is implied that the
technical infrastructure and IS processes could not exist without human intervention. For this reason, it is imperative to
include behavioral aspects in the study of IS agility. Gebauer & Schober (2006) include a variety of skills and attitudes of the
IT staff as a key component in IT flexibility. Both technical knowledge of the IS being supported as well as a deep
understanding of the business are needed by IT staff members to maximize flexibility (Duncan, 1995). IT education and
training, such that users, support personnel, and management have the knowledge and skills necessary to extract value from
the system, also promote greater agility (Weill et al., 2002). These studies, coupled with the implied involvement of human
beings from other studies represent what is referred to as “human characteristics” in this study.

DEVELOPMENT OF THE IS AGILITY CONSTRUCT

A review of the literature has resulted in the identification of three dimensions of IS agility: technical infrastructure agility, IS
process agility, and human characteristics. Based on the previous work cited above, we can define IS agility as the ability of
IT artifacts, of information stored within those artifacts, and of the underlying processes that support and maintain the
artifacts and information to quickly adapt to changing business needs. The three dimensions of this construct are broadly
defined and are multi-dimensional in nature. Therefore, it is necessary to break each down into several first-order dimensions.
Table 1 defines each first and second order dimension and the theoretical base for each definition. Further discussion of the
dimensions will follow.

<table>
<thead>
<tr>
<th>First and Second Order Dimensions</th>
<th>Definition</th>
<th>Support from Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Infrastructure Agility</td>
<td>Sets of technical component configurations and architectures that enable rapid and facilitated changes to information systems</td>
<td>Allen &amp; Boynton, 1991; Byrd &amp; Turner, 2000; Duncan, 1995; Fink &amp; Neumann, 2007; Gebauer &amp; Schober, 2006; Weill et al., 2002</td>
</tr>
<tr>
<td>Hardware Platform Agility</td>
<td>The ability to move application and system components across platforms and physical infrastructure such as servers and storage devices</td>
<td>Byrd &amp; Turner, 2000; Duncan, 1995; Fink &amp; Neumann, 2007; Gebauer &amp; Schober, 2006; Sambamurthy et al., 2003; Weill et al., 2002</td>
</tr>
<tr>
<td>Network Inter-Connectedness</td>
<td>The connectivity between IS components and the security and dependability of those connections</td>
<td>Byrd &amp; Turner, 2000; Duncan, 1995; Fink &amp; Neumann, 2007; Gebauer &amp; Schober, 2006; Goodhue et al., 2009; Lee, Siau and Hong 2003; Sambamurthy et al., 2003; Weill et al., 2002</td>
</tr>
<tr>
<td>Application Agility</td>
<td>The ability to quickly add, modify, or remove software components from the information system</td>
<td>Allen &amp; Boynton, 1991; Byrd &amp; Turner, 2000; Duncan, 1995; Fink &amp; Neumann, 2007; Gebauer &amp; Schober, 2006; Goodhue et al., 2009; Lee, Siau and Hong 2003; Sambamurthy et al., 2003; Weill et al., 2002</td>
</tr>
<tr>
<td>Information Agility</td>
<td>The ability to freely retrieve and share data between components of the IS and to users</td>
<td>Byrd &amp; Turner, 2000; Duncan, 1995; Fink &amp; Neumann, 2007; Gebauer &amp; Schober, 2006; Weill et al., 2002</td>
</tr>
<tr>
<td>IS Process Agility</td>
<td>A set of business processes that enable rapid and facilitated changes to information systems</td>
<td>Lientz, 1978; Boynton, Zmud and Jacobs, 1994</td>
</tr>
<tr>
<td>Maintenance Process Agility</td>
<td>The ability to quickly and easily perform system tasks to keep it in proper working order</td>
<td>Borjesson, Martinsson and Timmeras, 2006; Boynton et al., 1994; Byrd &amp; Turner, 2000; Duncan, 1995; Fink &amp; Neumann, 2007; Gebauer &amp; Schober, 2006; Goodhue et al., 2009; Lee et al., 2003; Sambamurthy et al., 2003; Weill et al., 2002</td>
</tr>
<tr>
<td>Planning Process Agility</td>
<td>The ability to quickly and easily evaluate and prioritize proposed system changes to ready them for development</td>
<td>Borjesson, Martinsson and Timmeras, 2006; Boynton et al., 1994; Byrd &amp; Turner, 2000; Duncan, 1995; Fink &amp; Neumann, 2007; Gebauer &amp; Schober, 2006; Goodhue et al., 2009; Lee et al., 2003; Sambamurthy et al., 2003; Weill et al., 2002</td>
</tr>
<tr>
<td>Development</td>
<td>The ability to quickly and easily implement</td>
<td>Borjesson et al., 2006; Boynton et</td>
</tr>
<tr>
<td>Category</td>
<td>Definition</td>
<td>References</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------</td>
</tr>
<tr>
<td>Process Agility</td>
<td>new functionality or modify existing functionality in an information system</td>
<td>al., 1994; Goodhue et al., 2009; Wang et al., 2008; Weill et al., 2002</td>
</tr>
<tr>
<td>Monitoring &amp; Assessment Process Agility</td>
<td>The ability to gather information and performance metrics in a rapid and efficient manner to evaluate system effectiveness and agility</td>
<td>Boynton et al., 1994</td>
</tr>
<tr>
<td>Human Characteristics</td>
<td>Sets of skills possessed by organization members that promotes quick and easy changes to information systems</td>
<td>Fink &amp; Neumann, 2007; Davis, 2009</td>
</tr>
<tr>
<td>Behavioral Skills</td>
<td>The interpersonal skills and social capital of IS personnel</td>
<td>Fink &amp; Neumann, 2007; Davis, 2009</td>
</tr>
<tr>
<td>Business Skills</td>
<td>The management skills and business process knowledge possessed by individuals within an organization</td>
<td>Borjesson et al., 2006; Byrd &amp; Turner, 2000; Duncan, 1995; Fink &amp; Neumann, 2007; Gebauer &amp; Schober, 2006; Weill et al., 2002</td>
</tr>
<tr>
<td>Technical Skills</td>
<td>The breadth and depth of knowledge of system architecture, programming, operating systems, and all other technical components supporting an IS of members in the IS department</td>
<td>Borjesson et al., 2006; Byrd &amp; Turner, 2000; Duncan, 1995; Fink &amp; Neumann, 2007; Gebauer &amp; Schober, 2006; Weill et al., 2002</td>
</tr>
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</table>

Table 1: Definitions of IS Agility First Order Dimensions

The first and second order dimensions that comprise the IS agility construct are graphically depicted below in Figure 1.

![Figure 1: Multi-Dimensional Construct of IS Agility](image_url)

**FIRST-ORDER DIMENSIONS OF THE TECHNICAL INFRASTRUCTURE AGILITY DIMENSION**

*Application agility* is derived predominantly from application functionality (Byrd & Turner, 2000) and IT-dependent system agility (Fink & Neumann, 2007). *Network Inter-connectedness* is akin to the notion of connectivity presented by Duncan (1995) and Byrd & Turner (2000) and the communication services cluster described by Weill et al. (2002). In essence, network inter-connectedness encompasses the connectivity between IS components and the security and dependability of those connections. *Hardware platform agility* aligns most closely with Weill et al.’s (2002) IT-facilities management services cluster and Byrd & Turner’s (2000) IT compatibility construct. Finally, *information agility* aligns with data transparency (Byrd & Turner, 2000), Weill et al.’s (2002) data management cluster, and IT-dependent information agility (Fink & Neumann, 2007).

**FIRST-ORDER DIMENSIONS OF THE IS PROCESS AGILITY DIMENSION**

Fink & Neumann’s description of IT-dependent strategic agility and Byrd & Turner’s (2000) technology management construct have similar qualities that relate to *planning capabilities*. An example of poor planning process agility is an organization that has a long backlog of system development requests such that the evaluation of such requests cannot be completed in a timely manner (Byrd & Turner, 2000). Agile development practices, as discussed by Borjesson et al. (2006), and the change management procedures investigated by Wang et al. (2008) both relate to *development process agility*. 

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Lientz, Swanson, Tompkins and Morgan (1978) focus predominantly on software maintenance procedures which presents a third process categorization: maintenance process agility. One example of high maintenance process agility is an organization that utilizes a weekly review and installation process for recently released system patches. Conversely, an organization which has a rigid process for installing system patches once per year would exhibit considerably lower levels of maintenance process agility.

To ensure content validity of the IS process agility dimension, a further review of literature specific to IS processes was conducted. The Control Objectives for Information and Related Technologies (COBIT) framework (version 4.1) was used as a starting point for analysis. Although not based on traditional academic rigor, the COBIT framework has been developed and enhanced by practitioners over the past 13 years. This framework was referenced as it aims to define all IS processes that organizations typically employ. COBIT provides four dimensions of IS processes: plan and organize, acquire and implement, deliver and support, and monitor and evaluate. The three dimensions emerging from the review of IS agility literature cover the first three dimensions of COBIT, but the fourth, monitor and evaluate, is not fully addressed. To further the content analysis, the 11 groups of IS processes presented by Boynton et al. (1995) were also reviewed. With the exception of administrative services, all processes were determined to fit into the dimensions previously mentioned or into the COBIT dimensions. Administrative services, comprised of financial administration and staff performance, are activities that could be classified as overhead and not directly related to IS, so this group of processes will not be represented in this paper.

Since the previous IS agility literature fails to cover the monitoring and evaluation processes documented in COBIT and Boynton et al.’s process groups, the addition of a fourth IS process agility dimension must be added to our model. Therefore, “monitoring and assessment process agility” was included in our definition of IS agility. Those organizations that provide daily or weekly performance metrics and dashboards regarding the success of system changes and implementations would be considered to have higher monitoring and assessment agility than those organizations that do not provide such information to management or do so on a quarterly or yearly basis.

FIRST-ORDER DIMENSIONS OF THE HUMAN CHARACTERISTICS DIMENSION

Human characteristics are represented in a number of prior studies and the delineation between technical skills and business skills are often highlighted. Duncan (1995) specifically demarcates between the two types of skill, as do Byrd & Turner (2000). Fink & Neumann (2007) also include behavioral capabilities, such as interpersonal skills, in addition to business and technical knowledge in their study. Davis (2009) investigated the social capital between members of the IS group and other business units and the impact of this social capital on agility. Based on these previous studies, three dimensions within the human characteristics dimension emerge: behavioral skills, business skills, and technical skills.

It should be noted that for all first-order dimensions in the human characteristics dimension, it is of paramount importance to evaluate skills at the organizational, rather than individual level. Individuals with a very deep understanding of a single technical component, such as the IBM DB2 database platform, may not contribute significantly to an information system’s agility as the knowledge and experience may create a competency trap. Evaluation of behavioral characteristics must be performed at the organizational level to ensure a complete picture of the skills possessed by the collective group is obtained. When assessed at the organizational level, behavioral, business, and technical skills should encompass a broad range of skills/competencies as well as a deep-rooted understanding or display of such skills and competencies.

As mentioned in the previous discussion, numerous studies have investigated individual components of IS agility. This paper attempts to synthesize all previous work in the area of agility to present a complete picture of the dimensions that form overall IS agility. Table 2 summarizes how previous literature addresses the dimensions developed in this paper and highlights the fact that no individual study to date has addressed all of the dimensions proposed in this research.
Table 2 – Prior Research Coverage of First-Order Dimensions

SCALE DEVELOPMENT FOR IS AGILITY

Item Generation

With the three second-order dimensions and 11 first-order dimensions defined, a content analysis of previous measurement tools was conducted to generate a preliminary pool of items. For each study that employed a survey instrument, the individual items were reviewed and sorted into the first-order dimension that they were believed to belong to. From the five studies for which survey instruments were utilized, a total of 118 items were compiled. To supplement the items identified from previous studies, additional items were drafted by the author and a panel of experts who are currently practitioners in the IS field. To ensure adequate coverage of all content domains, a minimum of 20 items per first-order dimension were generated (Netemeyer, Bearden and Sharma, 2003). This resulted in a total of 225 items generated across the eleven dimensions.

Scale Validation

The remaining steps in validating and finalizing this scale are yet to be performed however a brief overview of the intended procedures is provided in this paper (Netemeyer et al 2003; Churchill, 1979). To qualitatively assess construct validity, the initial pool of items will go through several rounds of item sorting. Initial item sorting will be performed by a panel of experts with no a priori definitions of the dimensions. Secondary sorting will consist of experts sorting items into the dimensions as defined by the researcher. Feedback will be solicited from the experts to rephrase items that are ambiguous or unclear and recommendations to drop items from the pool will be considered.

Upon completion of item sorting, the pool of items should demonstrate reasonable levels of content, convergent, discriminant validity. A pre-test will then be conducted using a convenience sample of respondents. The pre-test will consist of respondents rating each of the items on a 7 point Likert-type scale. Open-ended questions will ask respondents to comment on survey length, item wording, and any recommendations for improvement to the measurement instrument. The results of the pre-test will be reviewed by the researcher to identify whether additional items should be removed or reworded. Another qualitative assessment of convergent and discriminant validity will be performed on the results of the pre-test.

A pilot-test will then be conducted with a large enough sample size to allow for quantitative factor analysis of the results. Respondents will again be asked to rate each of the items on a 7 point Likert-type scale and provide feedback on survey length, item wording, and overall survey quality. The results of the pilot test will be analyzed using principle axis factoring to assess dimensionality, convergent, and discriminant validity. Items will be deleted and reworded where appropriate. Upon completion of the pilot test, it is the aim of the researcher to have a survey instrument of manageable length and has strong psychometric properties.

To finalize the scale, a full-scale field test will be conducted. The sampling frame will be individuals in management positions inside their respective IS departments. The field test will require respondents to rate all items in the scale on a 7 point Likert-type scale. Demographic information will also be collected from respondents to aid in assessing generalizability and testing for non-response bias. Convergent validity, discriminant validity, and reliability will all be assessed via confirmatory factor analysis to verify the psychometric properties of the scale and nomological validity will be assessed by embedding the scale in a nomological network of known antecedents and consequents.

CONCLUSION

This paper aims to define the domain of the IS agility construct by reviewing and synthesizing previous work in this field. The dimensions described above help us to understand the full spectrum of IS agility and can enable researchers to better assess the characteristics of agile information systems in future work. Upon completion of the validation and finalization
procedures, the scale developed through this work can be used by researchers to address numerous research questions relating to information system agility. Agility will continue to be an important topic for researchers and practitioners alike and it is the intention of this researcher to provide a reliable instrument for measuring this construct.

REFERENCES

THE INTER-ORGANIZATIONAL SYSTEM (IOS) ARTIFACT:
AN INTERPRETATIVE DISCOURSE

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ABSTRACT
A need for theory-based research covering IOS artifact has been cited by IS academics and researchers, wherein the subject of the research is the IOS itself, as opposed to the contexts within which the IOS gets acceptance. This paper attempts to define a simple proposition pertinent to the IOS artifact and in doing so identifies areas of research interest, which if pursued could potentially lead to theories for IOS that are explanatory, instructive and stand the test of IOS evolution.

Keywords
Inter-Organizational Systems (IOS), IS Artifact, Design Theory

INTRODUCTION
A compilation of past research on Inter-Organizational Systems (IOS) (Robey et. al 2008) suggests that the primary areas of research interests, thus far, have been pertinent to the state-of-art IOS as a phenomena, with emphasis on three main aspects of IOS; these are – (1) the factors that result in the adoption of the IOS, (2) transaction governance implications and (3) the impact of IOS adoption on an organization. The findings published (Robey et. al 2008), indicates that the main dimension of interest for IOS research has so far been organizational science - attempting to define and describe the value proposition of IOS in an organizational context, the organizational impact and the implications for governance. IOS has thus largely been studied as an organizational phenomenon. For example, (Messerschmidt 2009) discusses an adoption model that takes into account both intra-organizational and inter-organizational factors critical to successful adoption of grid computing. Chang et.al 2008 and McCabe et.al 2008 further evidence the study of the IOS as a phenomenon. Nevo at al 2009 further reiterate that the dominant theme of IOS research for papers published between the years 1977 and 2006 has been IS success. This has created a conspicuous need for theorizing the IOS artifact itself in order to create a distinct identity for it.

In addition to the above, in the month of Dec 2009, a search was performed on the AIS elibrary, using keyword “IOS”. The search uncovered 38 research papers that were published in the year 2009 all of which contained the keyword “IOS”. These papers were subject to further search, using the keyword “IOS”, which further narrowed the papers, that cover or reference the IOS artifact to 15. The other 23 papers, although contained the word “IOS”, did not reference the IOS artifact, but referenced other entities such as “scenarios” or “CIOs”. A cursory glance at the abstracts of these 15 papers revealed that 4 of these papers, presented findings relevant to the IOS artifacts, when considered as a sub-category of IS artifacts under analysis (Jeyaraj 2009, Karhade et al 2009, Nevo et al 2009) and thereby the IOS artifact itself was not the subject of the paper, instead the subject of the paper was trend analysis and findings pertinent to sub-categories of IS artifacts. 4 papers (King 2009, Messerschmidt 2009, Roberts et. al 2009, Williams et.al 2009) covered case studies that instantiated IOS artifacts. 1 paper (Hovav et. al) referenced the implications of the subject of the research, identity management, for the IOS artifact. 3 papers (Liu et. al 2009, Naik et. al 2009, Wunnava et. al 2009) covered the organizational impact of IOS focusing on the implications for achieving quality of service and competitive advantage if organizations were to adopt the IOS and use them in conjunction with their internal infrastructure capabilities. Finally, there were 3 papers (Corbiere et. al 2009, Frick et.al 2009, Madlberger et.al 2009) that treated the IOS artifact as the subject of the research and highlighted the features pertinent to the generalized IOS artifact. The limitations of the findings just discussed, lies in the fact that the search was restricted to papers published in the AIS eLibrary only.

This paper initially postulates a simple, definitional proposition, pertinent to the IOS artifact. Further dissection of the proposition reveals areas of research interests, pursuing which can potentially create theoretical foundations of IOS that can add to the body of research for IOS.
A SIMPLE PROPOSITION PERTAINING TO THE IOS

Proposition: An Inter-organizational system (IOS) is an IS artifact, that forges an alliance between two or more organizations, each of which choose to have a stake in the IOS entity.

Let us examine this statement more closely “An inter-organizational system is an IS artifact….” What is the implication of the IOS being a IS artifact? For the purposes of this paper, the definition proposed by Gregor and Jones in their work on “The Anatomy of a Design Theory” (Gregor, et. al, 2007), will be adhered to – which is to perceive IS artifacts as material instantiations of hardware and software. If IOS is a type of IS artifact, the diagram in Fig 1 further illustrates the relationship between IOS artifact and IS artifact and results in the identification of a well-known but thus far an implicit categorization of IS artifact which is the intra-organizational IS artifact. Let us choose the word intra-mural systems (IMS) to refer to systems that are created for the benefit of a single organization only.

As seen in Fig 1, the IOS and the IMS are types of IS artifacts and the main differentiating factor between the two types of IS, is in terms of ownership and support provided to business processes offered by the IS artifact which in the case of the IMS is a single organization and in that of IOS refers to the involvement of multiple organizations by definition. The IMS has existed since the inception of the IS artifact, both in theory and as material realizations, but with the emergence of the IOS, it has now become imperative to classify it as a separate class of IS artifacts, as opposed to using it interchangeably with the term “IS” – this would aid in a better understanding of the differences and similarities that exist between the IOS and the IMS as well as facilitate the creation of a distinct identity for IOS artifacts.

Figure 1. Generalization relationship between the IS artifact and the IOS

A useful area of research interest would be to study the aspects of IS artifacts in general, which by the property of inheritance makes these aspects significant and applicable for both the IOS and the IMS. To look at the key differences between the two artifacts would create separate and distinguishing identities for the IOS and the IMS. This study, of the points of similarities and differences, for the IOS and the IMS, can further explain factors that have an influence in artifact creation, such as the implications for the design patterns used for implementing the artifact, nature of technology used for implementing the IS artifact, degree of formality observed in engaging stakeholders, information security concerns, what is state-of-art for IOS and IMS implementations, human resource engagement and subsequent challenges and so on and so forth. For example, when observing and enforcing modular thinking in IS artifact design, in order to realize the benefits of using modularity, modularity used as a design precept is applicable for both the IMS and the IOS.

For the purposes of this paper, let us look at an IOS artifact instantiation and initiate a starter comparison between an IMS and an IOS. Let us take the scenario, wherein a customer wants to purchase a book from an online book store and is given the option to make a payment directly using a debit card or credit card or make a payment using her Paypal account. As can be seen in Fig 2, an IOS is at work here for facilitating the online purchase of a book. The IOS artifact, because it spans multiple organizations, is essentially a set of intra-mural systems each of which belong to distinct organizations and each of which partake in the collaborative endeavor that facilitates online purchase of the book.
The customer accesses the online bookstore which is essentially owned by the bookstore owner and makes decisions on which books to purchase from the website. In order to purchase the book, the customer is given the option to make the payment using either VISA or MC or her Paypal account. When the customer opts to make the payment online, essentially the customer invokes the IMSs owned by VISA, MasterCard or Paypal in order to complete the purchase transaction. The limitation of this case is that the IOS artifact under analysis is actually an extension of the IMS under evaluation and is not being compared to an independent intra-mural system such as a centralized database in another organization that has nothing to do with the infrastructure facilitating the online payment transaction.

The table below lists the attributes of interest for comparison purposes and their values for the entire IOS and the online bookstore’s IMS. As we can see from the table below, the IOS artifact and the IS artifact have differing stakeholder expectations with respect to the quality attribute. Further attributes of interest when identified and defined can be instructive of the distinct identity that the IMS and the IOS exhibits both actually and ideally.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Online Bookstore’s IMS</th>
<th>IOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of organizational stakeholders</td>
<td>1</td>
<td>At least 4</td>
</tr>
<tr>
<td>Technology used</td>
<td>State-of-art</td>
<td>Standard</td>
</tr>
<tr>
<td>Availability window</td>
<td>20/7</td>
<td>20/7: Online Bookstore 24/7 : Payment</td>
</tr>
<tr>
<td>Troubleshooting SLA s</td>
<td>6 hrs</td>
<td>6 hr: Online Bookstore 1 hr: Payment</td>
</tr>
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</table>

Table 1. Attributes of interest in comparing the IMS and IOS

Now let us look at the second part of the proposition – “An Inter-organizational system (IOS) is an IS artifact, that forges an alliance between two or more organizations, each of which choose to have a stake in the IOS entity.” The second part of the proposition – “forges an alliance between two or more organizations” emphasizes the IOS artifact as an agent for building relationships between two or more organizations. The alliances can be between competitor organizations or between
organizations that are part of a supply-chain or between organizations that belong to different industries (Nootenboom, 1999, Applegate et al 1999). Useful areas of research interests would be examining the individual benefits that organizations reap by virtue of the alliances and the costs involved. As an example, the relationships that IOS forge between organizations creates the opportunity of generating “social capital” for each of the participant organizations who signed up to be a member of the IOS network, which each of the organizations can leverage to further strengthen their individual positions in the marketplace.

As an example, OMGEO, a subsidiary of Thomson Financial, markets a product called OASYS Global, essentially an IOS, that can be used by multiple trading companies, each of which sign up to use OMGEO, to effect broker transactions between subscriber organizations. Thomson Financial here, acts as a third party vendor of the OMGEO platform to facilitate transactions that occur between different brokerage firms. Not only do participants in OMGEO’s global platform get to book and receive trade affirmations electronically (thereby transferring operational and regulatory risks to OMGEO), but also get to build trust based relationships, under reduced conflict conditions, with other brokerage firms at an organizational level as opposed to the individual trader level. As a result, organizations that sign up for OMGEO’s global trading system, not only significantly reduce operational and compliance risks but also have the opportunity to forge new trust-based relationships with other participant organizations, which in the absence of the IOS, were previously inaccessible, because of the size and position of the organizations in the marketplace. Studying the different types of B2B collaboration architectures and implications for each of the individual organizations can draw attention to the pros and cons of each type of collaboration architecture, which organizations can consider before making the commitment to sign-up for the IOS.

The third part of the proposition - each of which choose to have a stake in the IOS entity - focuses on the factors that motivate organizations to build a participatory stake in the IOS entity by virtue of organizations making a conscientious choice in engaging with the IOS artifact – which as mentioned in the Introduction, has been one of the primary and current areas of research interest for IOS. Due to the competitive environment within which organizations operate, this is an important area of research interest especially for competitor organizations (Cavaye et al 1995), because it focuses on the identification of collaborative solutions that are synergistic and worth pursuing despite the competition. Although status quo studies on IOS, primarily place emphasis on factors that influence IOS adoption and diffusion, such as the creation of a Standards Development Organization (SDO) that is industry specific and can be of benefit to organizations that belong to a specific industry (Nelson et. al 2006), it is critical that these factors continue to be evaluated in terms of how exemplary they are in influencing future IOS adoption. The important aspect of this motivation is the ability of the IOS artifact to address an organization’s need to have flexibility in maintaining the engagement with the IOS and minimizing the risk of dependence on the partnerships that an organization forges with other participants who have a stake in the IOS entity. Thus, while studying the descriptive features of state-of-art IOS, understanding organizational motivation and how to incorporate it in IOS design can further strengthen the business case for the IOS.

CONCLUSION

The paper highlights the fact that the IOS is a classification of IS and this property can be used in identifying the general characteristics of the IS artifact that the IOS artifact inherits as well as those that are unique to it. The second and the third part of the proposition, stated in the paper, while continue to focus on the organizational dimension of IOS they also allude to areas of research interest within the organizational domain that can influence the design of the IOS artifact. While the three areas of contemporary research interests mentioned in the Introduction are narrow in scope (Robey et al 2008), these research areas are critical in forging trust-based collaborative relationships, which can also prove to be symbiotic.

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BUSINESS PROCESS REDESIGN: IS IT STILL RELEVANT IN TODAY’S BUSINESS ENVIRONMENT?

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ABSTRACT

The concept of business process redesign or reengineering (BPR) has been around for about twenty years, and as technologies used in business and associated business practices have changed over the years, BPR has evolved as well. Reflecting these changes, various definitions and alternative names have been proposed for BPR. In this paper, we investigate the literature on BPR in order ascertain current uses, practices, and relevance of BPR in today’s business environment. Based on this review we classify BPR projects into three types according to business needs: internal, external, and traditional. We propose a simple framework that should help in determining the most appropriate approach in future BPR projects.

Keywords

BPR, business process redesign, reengineering, process renovation, process management

INTRODUCTION

The concept of business process redesign or business process reengineering (BPR) was introduced in 1990 by Hammer's article "Reengineering Work: Don't Automate, Obliterate", and BPR quickly became a new and hot buzzword in management (Markus et al. 1995). At that time, BPR was generally defined as a managerial approach to improving efficiency and effectiveness of business processes that exist within and across organizations (Boar 1993; Hammer 1990; Marcum 1993). Specifically, Champy and Hammer (1993) define BPR as "the fundamental rethinking and radical re-design of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed" (1993). The emphasis of BPR has been on redesigning business processes, using a radical information technology (IT) enabled approach to organizational change, to obtain dramatic and sustaining improvements in quality, cost, service, lead-time, or outcomes (Al-Mashari and Zairi 2000). Perhaps the simplest definition was provided by Davenport and Short (1990) who view BPR as "the analysis and design of processes within and between organizations."

In the early 1990's, BPR was mainly about headcount reductions, budget cuts, facility closures, and expensive consulting engagements (Jaklic et al. 2003). However, as business needs and practices are changing, the definition and use of BPR needs to change as well. To reflect some of these changes, Groznik et al. (2008) proposed to use business renovation (BR) instead of BPR. They justified this by stating that traditional BPR is a reengineering strategy, that critically examines current business polices, practices, and procedures, rethinks them through and then redesigns the mission-critical products, processes and services. But in addition to business processes, BR projects should also include new technological options as well as different organizational, economic and social views of organizations. BR integrates the radical strategic method of BPR and the more progressive methods of continuous process improvement (CPI) with adequate IT infrastructure strategies.

Since the introduction of BPR twenty years ago, organizations have been focusing on improving their processes. However, in recent years, standardizing many of these processes has become more important than ever (Attaran 2003; Terziowski et al. 2003), as organizations must increasingly compete in the global market and thus need a new approach to viewing business practices and processes (Adesola and Baines 2005; Aversano et al. 2002). Also, the rising development of inter-organizational relationships and significant improvement in business integration make BPR or BR a necessity. Redesigning business processes is required to facilitate processes across organizational boundaries and to integrate back- and front-office processes (Abdolvand et al. 2008)

The objective of this article is to support future applications of BPR or BR by providing a new framework for such projects based on current business environments and needs. The motivation for this framework is the emergence of new needs for BPR projects, which differ significantly from traditional BPR projects. This means that the traditional BPR frameworks, which were developed for various business scenarios may not be applicable to some of the current projects and may need to be adjusted. BPR in its nature is triggered by different factors, and these factors vary over time and from one environment to another. BPR projects have become a necessity for any radical change in the mechanisms of operating an organization, including, for example, managerial and technical changes due to e-government implementations (Groznik et al. 2008). At the
same time, some BPR projects may still be initiated for the traditional reasons, such as increasing efficiency, decreasing cost, and implementing new developments in the organization (Hammer 1990; Markus, et al. 1995; King 1996).

Many researchers have pointed out the fact that with new technologies and with changes in the managerial perspective in today’s environment, the traditional understanding of BPR and some of the traditional initiators of BPR have changed, and new ones have arisen in their place (Groznik et al. 2008; Jaklic et al. 2003). Therefore, we believe that there is a need for revisiting BPR concepts and to categorize BPR projects according to the current business needs, in order to gain a better understanding of BPR projects in today’s environments. A comprehensive view of contemporary BPR projects and a new framework will help practitioners in better planning their BPR projects, i.e. choosing the right strategies, people, managerial approaches, structures, and technology dimensions. Furthermore, this proposed framework will allow researchers to reassess the relationship between BPR and information systems (IS) by appraising the business and IS interactions within the different types of BPR projects (Kettinger 1997).

Our methodology in this paper basically follows a design science approach (Hevner et al. 2004), where the new framework is the designed artifact. The relevance of the problem has been discussed above. The search process is primarily a review of the relevant literature to identify the current business needs that require BPR, and the appropriate BPR lifecycles and procedures. This review will allow us to classify BPR projects accordingly, and to develop the new framework.

The rest of the paper is organized as follows: We summarize the traditional BPR environment in the next section, and following that we discuss new BPR directions. This comparison will help in introducing the proposed classification of BPR projects in today’s environment in the fourth section. Following that we present the new framework for BPR projects. Finally, we summarize the contribution of this paper and discuss future research in the conclusion section.

TRADITIONAL BPR

Traditionally, BPR has been considered a management approach aimed at improving efficiency and effectiveness of business processes within and across organizations (Boar 1993; Hammer 1990; Marcum 1993). Grover (1999) stated that BPR is used for fixing organizations’ woes; BPR was largely seen as a panacea for dealing with organizational ills and the latest recipe for business survival. The purpose of BPR was confined to increasing performance and reducing cost (Markus 1995; Al-Mashari and Zairi 2000).

Traditional BPR projects commonly follow the waterfall life cycle approach consisting of four major phases: (1) identifying the current processes, (2) analysis, (3) design, and (4) implementation and testing (Dewalt 1999). Al-Mashari et al. (2001) proposed a similar life cycle approach with six phases: (1) envision, (2) initiate, (3) diagnose, (4) redesign, (5) reconstruct, and (6) evaluate. Both approaches assume that there is an immediate problem and the BPR project is initiated to fix it.

As with any organizational project, there are two dimensions in measuring the success of a BPR project. One dimension measures the execution the project itself, including the planned and actual time frame and the cost of the project (Freeman and Beal 1992). This dimension is related to project management and is out of the scope for this paper. The other dimension is evaluating the effectiveness of the project, which is related to the change resulting from the BPR project and is traditionally measured in terms of performance outcomes. Although evaluating the effectiveness of a project seems to be very subjective, it can be measured via several objective criteria such as cost and cycle time, serviceability, and resource utilization. These criteria can be measured before and after implementing the BPR project, and the results can be compared (Hammer 1990; Grover 1999; Harmon 2003). However, in any BPR project there is hidden cost, called "knowledge change cost," that needs to be included when calculating the new cost for any process, i.e. the cost required for employees to learn and perform the new process (Kelly and Mohan 2005).

NEW BPR DIRECTIONS

In addition to the traditional needs for carrying out BPR projects, the unprecedented changes that organizations have been facing in the last 20 years, including globalization, mobilization, political realignment, etc., have created new needs for BPR. Also, the rapid advances in information technology have led to new business environments, such as e-commerce, making BPR necessary. In this section, we will discuss some of these changes and their impact on BPR, in order to show the need for a new classification of BPR projects and a framework for BPR implementation.

When implementing e-commerce, many companies have found out the hard way that existing business processes must be seamlessly integrated with the new, electronic form of interaction with suppliers and customers to obtain real business value. Some statistics in 2000 showed that around 90% of corporate e-commerce Web sites were not even linked with their back-office processes (Krzzywono's 2000), thus preventing the new technology to be truly effective. Jansen-Vullers et al. (2004) emphasized the process context of e-commerce, and provided guidelines to redesign business processes when e-commerce is introduced. Jansen-Vullers et al. based this need for BPR in e-commerce environments on the differences in the constraints.
that are in place for e-commerce processes as compared to conventional business processes. As an example, consider the 24-hours/7-days-a-week availability that is often a requirement for an e-commerce process, compared to the required availability in a conventional business process, which is usually restricted to regular business hours.

E-government is another development that forces organizations dealing with the government to redesign their processes in order to facilitate working in this new environment. Groznik et al. (2008) state that administrations must redesign the processes in the public sector as well as the technology infrastructure for successful e-government execution. E-government projects integrate information systems and business processes throughout the value chain and have a large impact on organizational business models. Groznik et al. conclude that e-government projects will not be feasible unless introduced hand-in-hand with BPR.

Enterprise resource planning (ERP) implementations also lead to fundamental changes within the organization’s structure, culture, and business processes, which create a need for BPR (Ribbers and Schoo 2002). Over the last several years a more integrated approach has evolved with respect to redesigning business processes and implementing ERP systems. BPR and ERP are not necessarily complementary, but they can be designed to support each other (Ziaul 2006).

Redesigning business processes has also become a necessity for any radical new systems development within an organization, which differs substantially from the traditional usage of BPR. Alter (2005) proposes the concept of a work system, which is not restricted to an information system or a hardware/software configuration, but rather a system that does work in an organization. In the work system life cycle, business process redesign and system development are integrated and collaborative efforts. This applies to any system development regardless of whether application software is purchased, developed from scratch, or developed by improving existing software (Alter 2009).

Finally, business process management (BPM), which focuses on aligning all aspects of an organization with the wants and needs of clients, may be an initiator for BPR projects. BPM is a holistic management approach that promotes business effectiveness and efficiency while encouraging innovation, flexibility, and integration with technology. BPM attempts to improve processes in an ongoing manner and may thus be described as a "process optimization process". It is argued that BPM enables organizations to be more efficient, more effective and more capable of change than a functionally focused, traditional and hierarchical management approach (Smart et al. 2008).

As we can see from the above examples, BPR projects are not always initiated just to reduce cost or to improve process performance, but rather process redesign becomes necessary for a variety of other reasons. BPR may be needed for internal systems development or because of external requirements such as e-government projects and e-commerce. In the latter cases, BPR projects may follow a different life cycle and use different procedures than in traditional BPR, and measuring the success of these projects may become very complicated and hard to quantify, as the process redesign is typically interrelated with other projects.

BPR CLASSIFICATION

In the previous sections, we have seen how some current BPR projects may differ from the traditional BPR paradigm. In this section, we will classify BPR projects from a business needs perspective. These business needs, which may initiate BPR, can be summarized as follows:

- E-government projects, which are initiated by the government and imposed on all government departments as well as all organizations that are involved in any kind of transactions with the government. This means that these organizations have to initiate their own BPR projects in order to make their processes compatible with the new requirements of e-government, although there is no performance or cost problem with the current organizational processes. The BPR team will not analyze the organization’s processes for performance or cost efficiency, but rather look at how to convert processes to meet the requirements for e-government (Groznik et al. 2008; Abdolvand et al. 2008; Jaklic et al. 2003).

- E-commerce projects, which are initiated due to pressures in the market that force organizations to switch part or all of their business to e-commerce in order to remain competitive. Similar to e-government projects, organizations have to initiate BPR projects in order to modify their processes to fit the new requirements, rather than to increase performance or reduce cost. Also, as with e-government projects, the BPR team will start the project by looking at how to convert existing processes to meet the requirements of the new environment, in this case e-commerce (Krzywonos 2000; Jansen-Vullers et al. 2004).

- System developments projects, which include all radical internal developments. The goal of these developments may include increasing performance, reducing cost, or expand the functionality of the system. BPR projects may need to be initiated in these circumstances in order to align and integrate the business processes with the new technology. The early tasks of the BPR team in these projects are to investigate the effects of these changes in technology and to redesign the
affected business processes to maintain the integrity of the systems within the organization (Alter 2009; Grover 1999; Kelly and Mohan 2005; Joachim and Alexander 2005; Freeman and Beale 1992).

- Enterprise systems projects, i.e. commercial-of-the-shelf (COTS) systems implementations that involve more than one business process, such as ERP packages, workflow systems, etc. Typically these systems require specific business processes in order to perform effectively and efficiently, and thus require initiating a BPR project in order to convert current business processes to meet the new requirements (Joachim and Alexander 2005; Rajiv et al. 1997; Grover 1999; Ziaul et al. 2006; Ribbers and Schoo 2002).

- BPM and traditional BPR projects, which include all BPR projects that are initiated directly to increase the performance or decrease the cost of a business process or group of processes. This type of BPR is not associated with other changes imposed on the organization, such as e-commerce, e-government, or enterprise system implementations; (Hammer 1990; Champy and Hammer 1993; Al-Mashari and Zairi 2000).

The above list of BPR project types shows that the business needs that trigger BPR projects may originate within the organization, or may be due to outside developments. Based on these business needs identified above, we group the BPR project types into three classes, as listed below.

1) **Externally initiated**: As discussed above, e-government and e-commerce implementations are examples where the initiation for BPR may come from outside the organization, without an internal need to fix or improve the organization’s processes. In fact, the actual reason for initiating BPR projects in these cases is to allow the organization and its processes to be able to work with the new requirements in the new environment that has been imposed externally on the organization. In this class of BPR projects, the life cycle of the project starts by gathering the requirements from the external party, rather than investigating the current business processes for weaknesses. Next, the BPR team will start investigating the applicability of the current business processes for the new environment, and thereby determine the required modifications in these processes. Past experience in working in the new environment (e.g. e-commerce) will be most helpful for the team in this type of BPR.

2) **Internally initiated**: As we have seen above, internal systems development projects as well as large COTS implementations are examples where the need for BPR comes from initiatives inside the organization. Similar to externally initiated PBR projects, the BPR life cycle starts with investigating the expected changes in requirements due to the new organizational systems, rather than examining the current business processes for potential to increase performance or reduce cost. After determining these requirements, the BPR team will need to redesign the affected processes to fit the changes.

3) **Traditionally initiated**: Though new types of BPR have emerged, conventional BPR continues to be relevant for keeping businesses competitive. These BPR projects are initiated by the same factors, as has been the case in the past 20 years, i.e. increase performance and decrease cost. Project team members in this type of BPR start the life cycle by identifying and analyzing the current business processes in order to find ways to increase performance or decrease cost. After that, they need to redesign these processes accordingly.

**BPR FRAMEWORK**

Expanding on the classification above, we now introduce a basic framework for BPR. This framework shows the various workflows for each class of BPR projects and should be useful in terms of planning and managing the implementation of future BPR projects. The workflows suggested for the different classes of BPR projects can be incorporated into different lifecycle models, e.g. a waterfall lifecycle or an iterative and incremental life cycle, and different methods and tools can be used within these workflows.

Numerous researchers have discussed the phases or workflows of the traditional BPR project lifecycle. These phases are shown in figure 1, and usually start by identifying and gathering information about the current business processes, then analyzing them to find out how to improve them. After the analysis, the BPR team will redesign the processes to increase performance and decrease cost (Hammer 1990; Champy and Hammer 1993; Al-Mashari and Zairi 2000).

On the other hand, as discussed above, the phases for other types of BPR are somewhat different. In BPR initiated by external factors, the BPR project usually starts by gathering the externally prescribed requirements, which necessitates having some experience in the environment to which the business processes need to be adapted. In a subsequent phase the BPR team will gather information about the current business processes in order to analyze them for compatibility with the new requirements and determine how they may be redesigned to meet the requirements. The redesigned processes then need to be tested and finally, put into production (Groznik et al. 2008; Abdolvand et al. 2008; Krzywonos 2000; Jansen-Vullers et al. 2004) (see Figure 1).

The phases or workflows for BPR projects that are initiated by internal factors are very similar to the ones initiated by external factors. They differ in that the initial phase for internally initiated projects is to gather information on and analyze the
changes that are expected as a result of the new system, rather than externally imposed requirements. The BPR team will analyze the impact of the expected changes on the current business processes, and redesign the processes as needed. The other phases are typically the same as with BPR projects that are initiated by external factors (Kelly and Mohan 2005; Joachim and Alexander 2005; Joachim and Alexander 2005; Rajiv et al. 1997; Ziaul et al. 2006).

Figure 1 shows the workflows or phases for the three classes of BPR projects. Though these phases are shown in the sequence that would typically be followed if a waterfall life cycle approach is chosen, they can also be repeated in an iterative project approach.

CONCLUSION

The concept of BPR first appeared around 1990 and since that time has taken on new forms or interpretations. In this paper we investigated the literature of BPR to determine the current state of BPR and the various forms it assumes in today’s business environment. The purpose was to determine if the concept of BPR is still relevant today, and if so, to come up with a simple framework that classifies, explains, and describes the various types of BPR according to how these BPR projects are initiated: i.e. by externally prescribed circumstances such as e-commerce or e-government initiatives; by internal changes in the organization due to new systems implementations; or due to the traditional reasons, that is, increase performance and decrease cost.

Our classification and framework differentiates between various types of BPR projects with respect to project motivation, lifecycle workflows, and requirements. This framework may help practitioners in planning future BPR projects by giving them a better understanding of what is involved in these various BPR initiatives. In addition, the proposed classification and framework may serve as a basis for future work by researchers in the area of business process redesign.

Future work may include refining and expanding the framework, and testing the framework for its applicability and usefulness.

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SOFTWARE DEVELOPMENT METHODOLOGIES, TRENDS, AND IMPLICATIONS

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ABSTRACT

The practice of software development has evolved steadily over the decades. Numerous methods and models have been proposed to enhance its efficiency and effectiveness. This paper reviews these methods and models, identifies the latest trends in the industry, and discusses their implications.

Keywords

Software development methods and models, software testing, life cycle models, agile methods.

INTRODUCTION

As software is becoming critical to almost every organization, software development, the set of activities that produce software, has become an important topic to software development educators, students, practitioners, and researchers. The practice of software development has steadily evolved from its beginning half a century ago. Numerous methods and models (e.g., life cycle models and agile methods), have been proposed to enhance software development efficiency and effectiveness. Currently, life cycle models are the predominant models used in software development, especially in large software development organizations; however, agile methods are on the rise, gaining ground on the life cycle models. This paper reviews these software development methodologies (i.e., methods and models), identifies the latest trends in the industry, and discusses their implications. The review of methodologies, the identification of these trends, and the discussion of their implications will be useful to software development educators, students, practitioners, and researchers.

SOFTWARE DEVELOPMENT METHODS AND MODELS

This section provides a review of software development methods and models, including the analysis-coding model, life cycle models, and agile methods. For each method or model, its strengths and weaknesses are identified. Note that these methods and models are "not mutually exclusive" (Sommerville, 2007, p. 65); indeed, they are often used together, especially for the development of large, complex, integrated, and real-time systems.

Analysis-Coding Model

In the 1950's, the software development process had only two steps: an analysis step followed by a coding step, as shown in Figure 1 (Royce, 1970). There was very little emphasis on testing. As such, there were no professional testers, and testing was often carried out implicitly by developers or end users to ensure that the program could run and also meet the expectations. This analysis-coding model was useful for small programs, but it became practically ineffective and inefficient for larger programs (Royce, 1970).

Figure 1. The Analysis-Coding Model (adapted from Royce, 1970)
Life Cycle Models

Subsequently, life cycle models were developed, with the intent to bring control and order into the software development process. Life cycle models divide the software development process into clear-cut phases, typically including steps such as analysis, design, coding, testing, and implementation (McKeen, 1983). Depending on the workflows among the phases, life cycle models can be categorized into sequential models (e.g., waterfall model, traditional V model, and PV model), progressive models (e.g., phased model), and iterative models (e.g., spiral model).

**Sequential Life Cycle Models**

Sequential life cycle models are those that have well-defined phases, with the development effort progressing through these phases (IPL, 1997). Examples include the waterfall model, the traditional V model, and the PV model.

**Waterfall model.** The waterfall model includes a set of sequential phases that flow downwards like a waterfall. These phases vary but typically include phases such as requirements analysis, program design, coding, testing, and operations (Royce, 1970). Waterfall models have well-defined boundaries and responsibilities for the stakeholders. The development process is normally well-documented because documents generated in the previous phase are required to be signed off before the development proceeds to the next phase (Sommerville, 2007). The major problem of the waterfall model is its inflexibility. It is especially ineffective and inefficient in "[responding] to changing customer requirements" (Sommerville, 2007, p. 67). With a waterfall model, testing normally gets started only after coding is complete. When defects are found, previous phases have to be revisited in order to fix them. This tends to cause a project to run over time and over budget (Tsai et al., 1997).

**Traditional V model.** The phases in a traditional V model are similar to those in a waterfall model. However, with the traditional V model, each testing activity is mapped to some development activity, as shown in Figure 2 (Pyhäjärvi and Rautiainen, 2004). On the left side, development activities, including requirements analysis, high-level design, low-level design, and coding, proceed from top to bottom. On the right side, testing activities, including unit testing, integration testing, system testing, and acceptance testing, are completed in a bottom-up fashion. Traditional V models have the same advantages and disadvantages as those of waterfall models.

![Figure 2. The Traditional V Model (adapted from Pyhäjärvi and Rautiainen, 2004)](image-url)

**PV model.** A PV model is similar to a traditional V model. However, the PV model separates each testing activity into two parts: test planning and test execution. Test plans (e.g., test specifications) are developed along with each development
activity, and the tests will be executed in reverse order after coding is complete, as shown in Figure 3 (Sommerville, 2007). Compared to traditional V models, PV models have an additional advantage in that the test plans can be completed earlier in the process, resulting in shortened overall development and testing time.

Figure 3. The PV Model (adapted from Sommerville, 2007)

**Progressive Development Life Cycle Models**

A progressive development life cycle model (also known as phased implementation or incremental delivery), shortens the time to market by delivering “interim” versions of the software with reduced functionality, a tradeoff that is often made in software development (IPL, 1997). Each individual phase within a progressive development life cycle may use a waterfall, traditional V, or PV model for its own development life cycle (IPL, 1997). Progressive development life cycle models provide the following major advantages (Sommerville, 2007): (1) customers can use the software after the first delivery, and therefore, refine their requirements, and (2) the highest priority functionality and features of the system are delivered first, and therefore, receive the most testing. However, with a progressive development life cycle model, it can be hard to define the "interim" versions of the software, especially when the user requirements are not specified in detail.

**Iterative Life Cycle Models**

A simplified iterative life cycle model consists of four major sequential phases: requirements analysis, design, implementation & test, and review (IPL, 1997). This model starts with requirements analysis, and proceeds through design, implementation & test just as the waterfall model does. However, for each cycle, a decision is made on whether the software meets all the requirements and is ready to release. If it is, the software will be tagged for final delivery; otherwise, the cycle will continue.

**Spiral model.** The spiral model, proposed in 1986 and refined in 1988 by Boehm, is one of the most renowned iterative life cycle models. The driving force behind the spiral model is evolutionary development, and its major goal is risk management. Each cycle of spiral involves a progression that addresses the same sequence of steps (i.e., requirements analysis, design, implementation & test), along with objective setting, risk assessment and reduction, development and validation, and planning (Boehm, 1986, 1988). With the spiral model, the highest priority features are defined and developed first, and then more features are added, refined, and implemented, incorporating feedback from end users during each cycle of the spiral. The spiral model is effective at minimizing risks which helps to decrease the project's probability of schedule and cost.
Agile Methods

Agile software development methods are basically iterative development approaches that focus on incremental specification, design, and implementation (Sommerville, 2007), while requiring full integration of testing and development (Talby et al., 2006). According to the Manifesto for Agile Software Development (http://agilemanifesto.org), agile methods value: (1) individuals and interactions over processes and tools, (2) working software over comprehensive documentation, (3) customer collaboration over contract negotiation, and (4) responding to change over following a plan. The intent is to produce high quality software in a cost effective and timely manner, and in the meantime, meet the changing needs of the end users.

There are many agile software development methods, with eXtreme Programming (XP) being the most prominent. Other agile methods include crystal methods, lean development, scrum, adaptive software development, dynamic systems development methods, and feature driven development (Highsmith and Cockburn, 2001; Sommerville, 2007). After a short planning stage, XP goes through analysis, design, and implementation stages quickly, as shown in Figure 4 (Dennis et al., 2005). A timebox, usually spanning one to four weeks, is used to ensure that new, enhanced software is ready to be delivered at the end of each iteration. XP principles and practices include incremental planning, small releases, simple design, test-first development, refactoring, pair programming, collective ownership, continuous integration, sustainable pace, and the presence of an on-site customer (Beck and Andres, 2005; Sommerville, 2007).

Test-driven development (TDD), the notion of “writing test cases that then dictate or drive the further development of a class or piece of code” (Murphy, 2005, p. 3), is an integral core practice of XP. For instance, at Parasoft Corporation (http://www.parasoft.com), at least one test should be written before coding for every task (Binstock, 2009). TDD’s ability to change a class’s implementation and re-test it with very little effort and time makes it a powerful tool for meeting changing client requirements during the course of a project (Murphy, 2005). Beck and Andres (2005) note that XP encourages communication, simplicity, feedback, courage, and respect. With quantitative and qualitative data, Talby et al. (2006) prove that agile software development improves development quality and productivity. For maximal success when using agile methods for software development projects, they suggest that an organization should (1) pay more attention to test design and activity execution, (2) work with professional testers, (3) plan for quality activities, and (4) manage defects.

TRENDS

Drawing upon previous reviews of software development methods and models, we identify three major trends in the software development practice. First, agile software development methods are gaining ground on life cycle models. Compared to life cycle models, agile methods offer several advantages. Agile methods can deliver working software faster. Agile methods are better at dealing with changing user requirements. And finally, agile methods promote better working relationships among all
stakeholders, including business analysts, developers, testers, end users, and project managers. Martens and Gat (2009) express it in the following way: “Agile is a systemic change. It drives cost down, quality up and service levels higher by making the entire process leaner, the entire staff more responsible, and the customer more involved” (p. 27). Moreover, empirical studies indicate that: (1) the traditional life cycle models are too inefficient and ineffective for the development of large, complex systems (Robey et al., 2001), and (2) more recent software development methodologies, such as agile methods and prototyping, can significantly improve development quality and productivity (Talby et al., 2006). Indeed, many large software development organizations, who generally use established life cycle models, are experimenting more and more with agile methods (Crispin and Gregory 2009; Lee, 2008).

Second, software testing is becoming an integral activity in the software development process. Software testing is indispensable in ensuring software quality (Cohen et al., 2004). Traditionally, testing has been viewed as a separate and distinct stage at the end of the software development process. However, the evolution of software development methodologies indicates that testing is no longer the culminating activity of the development process. Pyhäjärvi and Rautiainen (2004) argue that testing is “an integral activity in software development” and they recommend that “testing should be included early in software development” (p. 33). Schach (1996) also suggests that “testing should be performed throughout the software life cycle” (p. 277).

Third, software testers are playing a more important role in software development as a direct result of the second trend described above. The tester’s role has expanded in two ways. (1) The responsibilities of testers have progressed from "error finding" (Myers, 1979) to "quality assurance" (Hetzel, 1984) to "code verification and validation" (Bentley, 2005). (2) Testers are engaged earlier and throughout the software development process, which has been proven to be beneficial to a project team’s performance. For instance, Waligora and Coon (1996) present quantitative evidence that, by starting testing earlier in the development process, project performance, in terms of cost and cycle time, is improved without sacrificing the overall quality of the software. Engaging testers earlier also enables the team to catch defects earlier in the software development process. This helps to cut development costs, because fixing a defect detected in later phases tends to increase costs by one or more orders of magnitude (Tyran, 2006).

**IMPLICATIONS**

The trends in software development methodologies identified above have important implications, especially to the IS research community. First, as more software development organizations adopt agile methods (Trend 1), empirical studies are needed to clarify the impact of using those methods. Research questions may include: (1) Does the use of agile methods lead to a better quality product? (2) Does the use of agile methods lead to higher job satisfaction for the development team members? (3) Does the use of agile methods lead to improved working relationships among team members? (4) Does the use of agile methods lead to improved adherence to project budgets and schedules? (5) Does the use of agile methods lead to a higher level of project success? A better understanding of these questions and their answers would help any software development organization make critical decisions about adopting agile methods.

Second, as software testing is becoming an integral activity in software development (Trend 2), empirical studies are needed to explore the following research questions: (1) What are the best approaches to integrating testing into development? (2) How much, how often, and how intense should testing be done? (3) What will be the impact of adopting these approaches on overall project success?

Third, as software testers are playing a more important role in the software development process (Trend 3), empirical studies are needed to investigate the following: (1) How does the more important role that testers are playing in the software development process impact the working life of the testers? (2) How does this change impact the working relationship between testers and developers? (3) What additional skills are needed for these testers to be better prepared for this newly expanded role?

**CONCLUSION**

In this paper, we have reviewed software development methodologies, identified the latest trends of the practice, and discussed their implications. The contribution of this paper is threefold. The review of software development methodologies can help software development educators and students gain a solid understanding of the subject. The identification of the latest trends within the practice can help software development practitioners make better strategic and tactical development and career decisions. The implications discussed can serve to guide interested software development researchers in future research. It is our hope that this paper will instill knowledge, inspire creativity, and generate actions that are related to improved software development.
REFERENCES

APPLYING AGILE SOFTWARE DEVELOPMENT METHODOLOGIES TO BUSINESS PROCESS REDESIGN/MANAGEMENT (BPRM)

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ABSTRACT
Agile principles are known to improve and speed software development. In this paper we explore the relationship between stakeholders and business process redesign/management (BPRM), how stakeholder involvement affects BPRM, and present a short case study that illustrates how Agile principles and methodologies can be used to enhance the effectiveness of BRPM.

Keywords
User participation, stakeholder, stakeholder involvement, business process redesign, business process management

INTRODUCTION
Information systems development (ISD) research typically dwells on how stakeholder and user involvement or participation affected ISD projects (Markus and Mao, 2004). Recently research has turned its attention to stakeholder and user involvement in broader ISD projects, which include but is not limited to software. This paper will review the relationship between stakeholders and business process redesign/management (BPRM) and how stakeholder involvement affects BPRM, and present a short case study that illustrates whether Agile principles and methodologies can be used to enhance the effectiveness of BRPM.

The paper first defines terms that will be used and the effect of stakeholder involvement on system success is discussed. A case study illustrating how Agile principles and methodologies can be used in BRPM is presented, followed by conclusions and direction for future research.

DEFINITIONS
To begin the discussion, it is imperative to define the terms to reduce confusion among the various researchers' works. The terms defined herein have at times differing definitions in the literature, and at other times interchangeable or complementary definitions. In the context of this paper, the terms will be defined as follows.

Information System, Work System, System
Information systems can be comprised of any of the following: software, hardware, web-based front end, data warehouse, centralized or distributed hardware and software system installations, etc. While we do not discount the necessity to research each type of system individually, for this paper we will adhere to the broader adapted definition derived from Alter's (2001) research. Alter defines a "work system" as "a system in which human participants and/or machines perform a business process using information, technology, and other resources to produce products and/or services for internal or external customers." He argues that information systems are actually work systems "since they consist of human participants and/or machines performing a business process using information, technology, and other resources to produce products and/or services for internal or external customers." In this paper the term "system" will refer to Alter's definition for "work system," and will encompass the definitions for "information system," "work system," and "system."

Stakeholder and User
Stakeholder and user involvement begins in the requirements phase of ISD projects. Beecham, et al (2005) showed that in the literature the term "stakeholder" includes all practitioners, customers and users; all people affected by the system with direct or indirect influence on the system requirements" (Sommerville & Sawyer, 1997). Thus, stakeholders can be users, and users can be stakeholders. Markus & Mao (2004) reviewed the literature and found that stakeholders "are those who are likely to be affected by a solution, whose acceptance and use of that solution could be problematic, and who are therefore logical candidates for participating in solution development or implementation. Participants are the subsets of stakeholders who are actually given the chance to participate in solution development and/or implementation activities." Users can be participants,
and participants can be users. For our purposes, we will apply the term "stakeholder" to mean stakeholder, participant, customer, and user.

**Involvement**

The terms "user involvement," "user participation," and "user engagement" seem to be used interchangeably in the literature. Bachore & Zhou (2009) quoted Barki & Hartwick (1991) to define user participation as “referring to the various design related behaviors and activities that the target users or their representatives perform during the system development process” and user involvement when referring to a “subjective psychological state of the individual”. An additional term coined by Kappelman and McLean (1991) is "user engagement," which "includes both participation (the behavior) and involvement (the attitude) and refers to the total set of user relationships towards IS and its development." Cavaye (1995) describes user participation as a "set of operations and activities performed by users during system development." Several researchers have studied user participation and collaboration (for example, Mattia & Weistroffer, 2008; Alter, 2009; Mattia & Weistroffer, 2009). This paper will use the term "involvement" when referring to stakeholder involvement, participation, or engagement.

**BUSINESS PROCESS REDESIGN/MANAGEMENT (BPRM)**

Included in Alter's (2001) definition of a work system are business processes. Business processes can include (but are not limited to): new product or service development processes, marketing and customer-facing processes, internal work processes, information access and analytical processes, inter-organizational processes, etc. (Mohsen, 2004).

**The Effect of Stakeholder Involvement on System Success**

Recent literature reviews show empirically how stakeholder involvement/participation is important to system success. In their review, Harris & Weistroffer (2009) found that while a standard measurement for user involvement has yet to be established, "user involvement has the greatest impact on system success if the user is allowed to voice an opinion and make choices from predefined options." Additionally, they found that there is an optimal level of user involvement, but "involvement beyond certain levels may be counterproductive." Bachore & Zhou (2009) found in 46 empirical studies that not only does the open source software development model (Tsang, 1999) include substantial user participation, but that user participation has a positive impact on system success.

There have been several case studies that concern IS projects being used to bring about BRPM. However, an IS project alone is not sufficient. For example, Markus (1983) illustrated an effort by one company to use a financial IS to accomplish organizational change, only to be thwarted by politics. Cooper (2000) found that "even if political, cultural, and other social issues are overcome, successful IT-enabled reengineering can only result with the existence of creativity."

A possible solution for successful BPRM is to use agile methods in BPRM.

Luna-Reyes, et al (2005) proposed a feedback-rich framework which appears to be similar to Agile methodology – the stakeholders give feedback concerning organizational change. In light of this and the aforementioned case studies, it behooves us as researchers to explore how best to apply agile methods to BPRM projects.

David Norton (2008) determined that BPRM needs to be a mix of discipline and agility, not the waterfall methodology that seems to be used by teams when they are presented with a BPRM project. He likens BPRM release cycles (i.e. a continuous cycle of design and optimization, iterations of fewer than six weeks, new policies and rules in a day) to Agile methodologies. Agile principles stipulate, among other things, an iterative approach to building software one small increment at a time, integrate stakeholder feedback at all stages, and recommend the assessment of the work done in each cycle in order to improve the process and better meet customer expectations. Reza Shafii (2008) asserts that there are two compelling reasons that an agile methodology would be well suited for the iterations of a BPRM cycle: 1) Each business process is modeled, and 2) as BRPM is by nature continuous improvement. He relates that

by modeling a process, business analysts are, in fact, also creating a software execution model, just like developers are doing when designing and writing code. It is therefore reasonable to deduce that the same lessons learned from the failures of the waterfall model for software development, namely the difficulty of coming up with an accurate and complete set of requirements and design from the get-go and its associated problems, should also apply to process modeling. By the same token, it can be reasoned that the use of an agile methodology for BPM would help alleviate these problems. Second, given the assertion that BPM is an implementation of continuous improvement—as established in the first section of this article—it would be natural for it to call for a methodology that also embraces this philosophy, and, as we have seen, agile methodologies fit this requirement.
Shafii further illustrated that there is no existing BPRM standard in use today and recommends that BPRM analysts evaluate their current methodology against the principles of the agile manifesto to determine if perhaps it could be improved by using the principles therein, such as:

- Is the methodology iterative and incremental?
- Are the iteration lengths relatively short?
- Does the methodology allow for significant changes to requirements throughout the iteration?
- Does the methodology embrace communication and feedback between business analysts and the business users

Agile software development methodologies are a well-researched area and are beyond the scope of this article; Dybå and Dingsøyr (2008) cite numerous studies on agile methodologies. We will touch but lightly on agile software methodologies.

In Agile software development methodologies, stakeholders and users are involved in the ISD project from the very start. The principles in the Agile Manifesto includes "Business people and developers must work together daily throughout the project" (Agile Manifesto).

Qumer and Henderson-Sellers (2008) define an agile software development method as one that focuses on people:

A software development method is said to be an agile software development method when a method is people focused, communications-oriented, flexible (ready to adapt to expected or unexpected change at any time), speedy (encourages rapid and iterative development of the product in small releases), lean (focuses on shortening timeframe and cost and on improved quality), responsive (reacts appropriately to expected and unexpected changes), and learning (focuses on improvement during and after product development).

For example, Extreme Programming (XP), an agile development methodology, has a set of values which includes feedback. The circular feedback from the customer to the developer and back again considers that "every contributor to the project is a member of the “Whole Team,” a single business/development/testing team that handles all aspects of the development. Central to the team is the “Customer,” one or more business representatives who sit with the team and work with them daily," and the customer is "a single person who can represent the requirements, acceptance criteria, and business value for the project," but is actually "a team of people that communicates with one voice with the Programming Team" (Lindstrom & Jeffries, 2004).

Our case study will examine whether agile development principles and methods can be used to redesign the business processes quickly, effectively, and accurately aligned with the stakeholder requirements.

**CASE STUDY**

A pharmaceutical company was closing domestic and international research facilities. To comply with FDA regulations and legal requirements, an IT transition was necessary in which IT assets (hardware, software, and most importantly, data) were to be retired, consolidated, migrated, or archived. The FDA requires that all data (paper and digital) regarding drugs or drug compounds be archived in perpetuity. In addition, legal requirements for intellectual property and foreign nations’ requirements must also be met. Unfortunately, the company was floundering with flawed processes which were onerous and unfit for the IT transition task at hand. This case study reviews the redesign of business processes at a research facility in Japan which was being closed.

Due to the closure of the research facility, the overall IT transition project was outsourced to a consulting firm to eliminate possible damage by disgruntled employees. The author was one of two team managers of a 40-person project team made up of project managers, business analysts, technical subject matter experts, technical writers, and other administrative personnel. This project team worked closely with counterparts in the US and European offices, which were receiving archival data, hardware, and software. Though there were over 90 separate projects to migrate, archive, consolidate, or retire hardware, software, digital and paper data, and other drug-related assets, to comply with length restrictions this case study will only focus on a few projects.

Based on previous software development experiences and familiarity with agile methodologies, the team managers decided to test whether agile development methods could be used to redesign the business processes quickly, effectively, and accurately aligned with the stakeholder requirements. A review of system yielded several business processes which could be improved. One such process was the data archival process, which included 17 major steps and took nearly 1 month to complete (see Figure 1). By contract, the archival process of paper-based lab notebooks had a total of 4 major steps and took less than 2 weeks.
Following agile principles, the BPRM iterations went roughly as follows:

1. process review and analysis
2. process modeling or re-modeling
3. process implementation
4. process monitoring and evaluation

Starting with a model of the system's current business processes, the team brainstormed about how to better achieve the IT transition goals. The processes were re-modeled, and the team then implemented the new model. The team met with stakeholders and customers on a regular basis to review their process change efforts and determine the stakeholder and customer approval.

At step one of the BPRM iteration, the team and stakeholders reviewed and modeled the current business processes and analyzed them for weaknesses and areas of improvement (Figure 1). Stakeholder involvement yielded invaluable input at this step, particularly in the areas of corporate policy, and legal and FDA requirements. At step two, the weaknesses and areas where improvement was needed were re-modeled, again with stakeholder/customer input. Site-specific needs were discovered, redundant steps were analyzed and some subsequently deleted, etc. During each iteration the resulting model was put into place during step three, which required little stakeholder involvement, except where direct participation was necessary. The process monitoring in step four began upon process implementation, and the process evaluation occurred within two to three days, depending upon the scope and effectiveness of the change.

During the iterations, several challenges had to be dealt with; for example, opposite time zones, language, signature requirements, corporate data security policies, etc. Many meetings occurred during the working hours for the overseas counterparts – evenings in Japan. This necessitated extra meetings the following day with local stakeholders. Video conferences or conference calls obviated some meetings, but dealing with differing time zones offset the anticipated speed of iterative redesign efforts. Company policy of electronic signatures on project documents also presented a challenge as that...
technology had yet to be implemented in Japan. Japanese file names caused major problems as the archival vendor had not expected double-byte file names (this was subsequently resolved by compressing several Japanese files as one file with an English file name). At the end of several weeks, the data archival process was reduced to 12 major steps and required only 5 days to perform (see Figure 2).

Within 3 months, the BPRM cycle had undergone several iterations. The given example is illustrative of most of the redesigned business processes that were clearly more effective and efficient, requiring less time and effort while accomplishing the goals of the IT transition and meeting the legal and FDA requirements.

**CONCLUSION**

Though our experience is currently limited to one case study, we have seen that Agile software development principles and methodologies can serve as an effective methodology for BPRM. The constant stakeholder involvement in redesigning processes allow BPRM analysts to ensure the redesigned processes are aligned with stakeholder needs and requirements. Though at times meeting with stakeholders may be difficult due to geography, language, or other barriers, making the effort to work with stakeholders at each step of the redesign yields invaluable results during a BPRM cycle. While the speed of testing in Agile development was not realized during BPRM, the BPRM cycle time was improved.

Future research plans include testing whether other Agile development principles and methodologies, such as pair programming, can be adapted to BPRM.

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**Figure 2: Data Archival Process After BRPM**

*(each step contains one or more sub-steps)*

<table>
<thead>
<tr>
<th>Compile documentation</th>
<th>Intra-site steps</th>
<th>Inter-site steps</th>
<th>Data Archival steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capture data and system information from interviews</td>
<td>Create data packages (data plus metadata)</td>
<td>Move data to receiving staging area</td>
<td>Load data into archival data center</td>
</tr>
<tr>
<td>Determine FDA &amp; legal requirements for data and systems</td>
<td>Mark source data and equipment for new disposition (ready to retire after data is moved)</td>
<td>Verify data integrity</td>
<td>Verify data integrity</td>
</tr>
<tr>
<td>Prepare and review required metadata (in English)</td>
<td>Delete source data and retire equipment at source site</td>
<td>Delete data from receiving staging area</td>
<td>Review &amp; Sign Off</td>
</tr>
<tr>
<td>Determine archival space requirements</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Checkpoints:

- **Requirements/Scope**: Mark equipment and data for new disposition
- **Intra-site**: Clear site storage area
- **Inter-site**: Clear receiving storage area
- **Data Archival**: Clear receiving storage area

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DISTANCE EDUCATION USING CONSUMER-LEVEL HARDWARE AND SOFTWARE

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ABSTRACT
A report on a proof of concept experiment to provide a distance education experience using consumer-level hardware and software while maintaining acceptable quality levels in video, audio, and text display.

KEYWORDS
Distance Education, Skype, Skype shared desktop, consumer-level hardware and software

INTRODUCTION
The traditional “lecture to a classroom of students” paradigm is constrained by geography and is outdated in the age of globalization. Globalization creates the need to provide access to educational resources to anyone, anywhere, at any time. Most often these educational resources are non-interactive. They are in the form of text or pre-recorded video, or audio. The ability to design and implement interactive education experiences enhances the learning of the participants and providers. The ability to provide these educational experiences regardless of geography increases their utility.

Using telecommunications technology and the Internet, the constraint of geography is easily overcome. Interactive distance lectures are nothing new in the university environment. However, with these there is an economic constraint determined by the equipment and facilities needed to provide an acceptable level of quality to the interactive session. In addition, there is a physical constraint in that the provider and participants need to be in specific locations. The provider needs to be in a studio-like facility to produce the near real-time interactive experience. The participants need to be in facility that is capable of receiving the presentation in its production format. Both the producer and participants need to have symmetric facilities. In a global education environment, an asymmetry of education facilities is likely, in particular, with regard to interactive media.

These issues lead to the thesis of the experiment stated below.

THESIS
The thesis is: use existing techniques that provide inexpensive real time interactive educational experiences independent of specialized facilities and geography. The following is a description of the experiment which allowed us to realize our thesis.

EXPERIMENT
Scenario for the Experiment
A colleague at Wuhan University of Science and Technology (WUST) requested that I honor him by guest lecturing to his current class. His course was a graduate course on IT Service Management. The course was based on the theme of the book by Jan van Bon – “Foundations of IT Service Management: Based on ITIL”. Please refer to [5] for details.

Content used for the experiment
For the sake of completeness we describe the content of the presentation. In Dr. Zhang’s course, students had learned basic principles of IT service management. Dr. Zhang requested I present a case study from the real world from a different perspective. He requested a discussion of how IT services are provided at Washburn University. In particular, he requested addressing the following questions:

1. From the service providers perspective, how the ITS at Washburn University aligns IT services with the business needs of the university and how the services are provided.
2. From the user's perspective, how students and faculties at Washburn University access the IT services?
3. Is there any conflict between the services provided and the expectations, and how had the conflicts been solved if there were any?

### Constraints

In essence, what was requested was a presentation of static information concurrent with an interactive session over the material that was being presented. The constraints were: content presentation and interaction were over widely separated geographic locations and a time difference of 14 hours.

The time difference was simple to solve. The presentation would take place on December 20th at 6:30PM and be viewed December 21st at 8:30AM.

The solution to the geographic locations constraint was solved by the use inexpensive consumer-based communication technology.

### Implementation

A real time and interactive educational experience of acceptable quality was required to meet the needs of presenting the case study. This was achieved by using existing inexpensive technology.

Initially we agreed to use Skype voice and video to lecture and student-lecturer interaction. MS-SharedView would be used simultaneously to display the power point slides (PPTs) required for the lecture. Both Skype and Shared View are available for no cost.

**Skype**

Skype is a free application that allows users to communicate using voice or text messaging in real time. In addition, it provides video conferencing between two users. Please refer to [6] and [7] below for more detail.

**SharedView**

SharedView is an application provided by Microsoft that allows up to 15 users to participate in a joint session. Please refer to [4] below for more detail. A joint session is initiated by a user extending an invitation via e-mail that contains the necessary information to join the session. The user extending the invitation can share his/her desktop or a portion (i.e. a specific application) with those users who accepted the invitation.

SharedView was intended to be used to present the necessary static information of the case study – i.e. the PPTs. A preliminary test found that the lag time between slide transitions on the provider’s side was too long on the participant’s side. It was too easy for the provider to “out talk” the slide on the participants side. Clearly this would lead to confusion.

**Skype Shared Desktop**

The Skype software’s most recent version allows for a “shared desktop”. As the name suggests a Skype user can share his/her desktop or a specific application to another Skype user. A user may share all or part of the desktop. Please see [1] for details.

### Solution Used

The final implementation used Skype utilizing two “channels”: one for voice/video and a second for PPTs using Skype’s shared desktop. Each channel is established between two computers each having users with unique Skype IDs. Figure 1 below provides a logical view of the implementation.
Each side of the communication utilized two PCs, one for static information (PPTs) and the other for interactive information (video and voice). The PCs used for interactive information employed webcams with microphones and had auxiliary speakers attached to the PCs.

To improve video resolution quality, webcams were used. The cost of these was less than $100.00 USD. In addition, changes were made to the Skype configuration file that would enhance the video resolution. Please refer to [2] for the details on the changes made to this XML file in order to capture an improved video resolution.

Because of the timing of the case study presentation, classes had ended at Washburn University; the provider used his small office home office (SOHO) facility to provide the case study presentation. The participants, since classes were in session, were able to use a university computing environment to receive the presentation. Figure 2 below illustrates the physical implementation of the experiment.
On the provider’s side please note the upload and download bandwidths. This will affect the participant’s experience of the presentation.

Results

Participant’s Side

In a subsequent e-mail Dr. Zhang, on the participant’s side, reported the following, quoting the e-mail,

“The PPT slides we saw on our screen are of high quality, without blur. I think the delay didn't exceed 0.5 second when changing slides, and the movement of your mouse pointer on a slide transmitted to my side almost in real time, however the video quality was not good enough, it stalled couple of times. I guess it were due to the limited upstream bandwidth provided to home users, if you could see my image consistently. Hopefully universities’ campus networks can provide wider bandwidth when someone offering a credit course remotely.”

Provider’s Side

From the provider’s side the follow observations were made.

Based on the question and answer session following the presentation, the experiment using Skype and Skype Shared Desktop was an effective and useful presentation for the graduate students. This implies that the presentation method was effective.

The provider reports that student interaction during and after the presentation was similar to lectures given on site at University Y in China. In effect there appeared to be no difference between on-site information delivery and remote information delivery.

CONCLUSION

Given Dr. Zhang’s comments above, the last solution solves the problem but with limitations.

Cons

It appears SOHO’s Upload bandwidth may not be sufficient for acceptable real-time video.

Pros

This solution is at minimal cost. Skype is free and a quality web cam with microphone is less than $100.00 USD

There is no intuitional overhead. No distance learning studio or proprietary software is required.

These types of quality learning experiences can be spontaneous. Dr. Zhang made his request on December 4th and the case study presentation was delivered on December 20th.

The provider believes this method of information delivery is as effective as traditional methods.

Future Actions

As Dr. Zhang states: “It (this experiment) demonstrates that some kind of remote education can already build upon consumer-level equipments and software, which facilitates many new education paradigms.”

As an example, by employing Skype and other technology Washburn University professors can offer lectures on18 of 36 lecture hours required for three hours credit to WUST students remotely. Then the Washburn University professor comes to WUST to finish the whole course. The deans of WUST like the idea. This Skype lecture is a starting point for such practice.

ACKNOWLEDGMENTS

We wish to acknowledge the graduate students of WUST willing to participate in this “adventure.”

Professor Boncella wishes to acknowledge his colleague, Professor Zhang, who is always willing to “push the envelope” in order for his students to have unique educational experiences.
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**ABSTRACT**

As eBook eReaders become more popular for personal use why are they not seen more in academia? In particular, would students benefit from using eBook eReaders in academic program? This paper means to investigate the current academic use of eBooks and eReaders including PC/laptops/netbooks as eReaders. As part of the investigation we conducted a small pilot study of graduate students enrolled in an eBusiness strategy course and reviewed existing research. However, current research is very limited in the area of eBook devices (eReader). This paper proposes a framework to classify and evaluate eBook eReaders, reviews the limited existing research then develops some hypotheses on the usefulness of eBook eReaders. The findings will indicate that enhancements are still needed for eBook eReaders in the area of collaboration and personalization before they are ready for academia.

**Keywords**
eReaders, eBooks, electronic books, framework, conceptual model

**INTRODUCTION**

Since Johannes Gutenberg’s invention of the printing press in 1440 advances in printing technologies have reduced the cost of books. However, the book you read today is not that much different than one created by Gutenberg’s press. However, in the digital age tremendous potential advances in content access exist that are not yet fully exploited in most academic settings. Advantages of digital access include flexibility, ability to link various texts, ability to display content in different formats, ability to link multimedia, ability to search and enhanced ability to share knowledge (Gordon 2002).

While eBooks can be read on any computing device, the recent emergence of eBook readers has created a renewed interest in delivery of these resources. Interestingly, research regarding the usage of eBook eReaders (as summarized later) has shown equivocal results. One of the primary reasons for such results is the wide variety of devices on which digital books can be read. These devices include PCs, iPhones, Sony readers, Kindle eReaders and netbooks to name a few. However, despite the number of devices no framework exists yet to classify these devices.

This paper provides such a framework. The framework provides two important outcomes. First, it provides a way to classify the various eBook eReaders. Second, this framework helps us understand existing research and draw hypotheses regarding the effectiveness of new enhancements to eBook eReaders. We conclude that even though knowledge integration dimensions are high in the eReaders that deficiencies in collaboration and personalization features leaves the eReaders lacking necessary features to support use in academia.

**EBook reader Classification Framework**

In 1971 Michael Hart started Project Gutenberg. The goal of this project was to digitize and archive cultural works (Hart, 2004). As computer hardware evolved so did the digitalization of books. Eventually the product of digitalization became known as eBooks. By the early 1990’s eBooks were available for purchase on floppy disks to be read on personal computers. The PC is already ubiquitous in most homes and remains the most common device for reading eBooks. However, a drawback to the PC or even laptop for reading books is that even small laptops and netbooks are relatively unwieldy when compared with a traditional bound book.

In 1998 SoftBook Press, Inc. is given credit for the introduction of the first dedicated eReader. The eReader is a lightweight high-capacity electronic book replacement. A review of the academic and practitioner literature since then shows that a wide variety of devices has emerged in this field. These devices are getting used in different academic settings. Additionally, these devices have a diversity of non-comparable features, making it difficult to compare the impact of these devices.
Thus, before we present a review of a literature it is important to present a framework to understand these devices. Since eReaders are knowledge devices we use a framework developed by Gupta et al. (2005) to classify different eBook eReaders. The framework provides three dimensions for evaluating knowledge tools: Knowledge integration, collaboration and personalization. The variety of features can be classified with these dimensions. We discuss each one of these in the context of eBook readers below. The discussion is summarized in Table 1 (with examples from eReaders available in the US).

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Knowledge Integration</th>
<th>Collaboration</th>
<th>Personalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristic</td>
<td>Able to read PDFs without conversion</td>
<td>Library sharing</td>
<td>Minimal customization of information based on user feedback</td>
</tr>
<tr>
<td>Kindle</td>
<td>N</td>
<td>Kindle</td>
<td>N</td>
</tr>
<tr>
<td>Smart Phone app</td>
<td>Y</td>
<td>Smart Phone app</td>
<td>N</td>
</tr>
<tr>
<td>PC/laptop/netbook</td>
<td>Y</td>
<td>PC/laptop/netbook</td>
<td>Y</td>
</tr>
<tr>
<td>Sony</td>
<td>Y</td>
<td>Sony</td>
<td>Y</td>
</tr>
<tr>
<td>Internet connection</td>
<td></td>
<td>Peer to peer lending</td>
<td>Ability to take notes in margins of eBooks</td>
</tr>
<tr>
<td>Kindle</td>
<td>Y</td>
<td>Kindle</td>
<td>N</td>
</tr>
<tr>
<td>Smart Phone app</td>
<td>Y</td>
<td>Smart Phone app</td>
<td>N</td>
</tr>
<tr>
<td>PC/laptop/netbook</td>
<td>Y</td>
<td>PC/laptop/netbook</td>
<td>N</td>
</tr>
<tr>
<td>Sony</td>
<td>N</td>
<td>Sony</td>
<td>N</td>
</tr>
<tr>
<td>Text to speech</td>
<td></td>
<td>Note sharing for study groups</td>
<td>Personalize screensavers with user photos</td>
</tr>
<tr>
<td>Kindle</td>
<td>Y</td>
<td>Kindle</td>
<td>N</td>
</tr>
<tr>
<td>Smart Phone app</td>
<td>N</td>
<td>Smart Phone app</td>
<td>N</td>
</tr>
<tr>
<td>PC/laptop/netbook</td>
<td>Y</td>
<td>PC/laptop/netbook</td>
<td>Y</td>
</tr>
<tr>
<td>Sony</td>
<td>N</td>
<td>Sony</td>
<td>N</td>
</tr>
<tr>
<td>Display using elnk allowing the user to have less eye strain</td>
<td></td>
<td>Ability to quickly adjust the size of the display using elnk</td>
<td></td>
</tr>
<tr>
<td>Kindle</td>
<td>Y</td>
<td>Kindle</td>
<td>Y</td>
</tr>
<tr>
<td>Smart Phone app</td>
<td>N</td>
<td>Smart Phone app</td>
<td>Y</td>
</tr>
<tr>
<td>PC/laptop/netbook</td>
<td>N</td>
<td>PC/laptop/netbook</td>
<td>N</td>
</tr>
<tr>
<td>Sony</td>
<td>Y</td>
<td>Sony</td>
<td>Y</td>
</tr>
<tr>
<td>Compatibility with non-proprietary file formats</td>
<td></td>
<td>User adaptive program for mobile education</td>
<td></td>
</tr>
<tr>
<td>Kindle</td>
<td>N</td>
<td>Kindle</td>
<td>N</td>
</tr>
<tr>
<td>Smart Phone app</td>
<td>Y</td>
<td>Smart Phone app</td>
<td>N</td>
</tr>
<tr>
<td>PC/laptop/netbook</td>
<td>Y</td>
<td>PC/laptop/netbook</td>
<td>Y</td>
</tr>
<tr>
<td>Sony</td>
<td>Y</td>
<td>Sony</td>
<td>N</td>
</tr>
</tbody>
</table>

Table 1. Dimensions of knowledge tools for commonly found models of eReaders released in 2009

Knowledge integration: Knowledge integration refers to the comprehensiveness and accessibility of codified knowledge in a firm’s knowledge base (Gupta et al. 2005) (Sambamurthy et al. 2003). In an eBook eReader context it is represented by the ease which the various eReaders transfer information from the reader to the user and between different types of eReaders. Of
the dedicated eReaders the Sony eReader can not only read eBooks formatted in Sony’s proprietary format, but can also read PDFs, txt, rtf and ePub file types. In addition to being able to read many text formats the Sony eReader can play MP3s and ACC audio formats. Plus, the Sony eReader can display jpeg, gif, png and bmp which are all common image formats.

Current weakness across all platforms: Lack of integration across different types of eReaders is a weakness in the current set of products. There is a limited availability of textbooks in eBook format.

Collaboration: Collaboration is the ability to conduct a conversation while maintaining a common frame of reference (Schrage 1997). Digitized books can serve as the common frame of reference. Collaboration brings together the explicit knowledge within the eBook with the tacit knowledge that individual MBA students possess (Nonaka 1994; Polanyi 1967). To this point this dimension is greatly lacking in most commercial eReaders. The only significant collaboration function at present is note sharing. However, note sharing between students or professor and student is only available on the PC versions of eReaders. At time of publication a new eReader called the Nook was released by Barnes and Noble. The Nook is unique in its ability to allow users to lend books to other users of the device.

Current weakness across all platforms: Features to connect users for global study groups are not robust or integrated. There is a lack of real-time collaboration features.

Personalization: Personalization is the extent to which the device can be customized to fit a specific users needs (Gupta et al. 2005). Personalization significantly impacts the ability to transfer knowledge since it presents presorted knowledge based on individual needs (Ho et al. 2008; Mayer et al. 2004). Technology supporting learning material creation customized based on student feedback exists for PC versions of the reader but is not in use.

Current weakness across all platforms: Ability to move chapter information based on user or professor’s preferences does not exist. No user friendly customization to allow users to tailor learning to their particular level or learning style.

Dimension outcome: Taken together the set of dedicated eReaders that were used in the pilot had no clear winner. Sony had the most points but by a small margin and the criteria used were not comprehensive. There is much room for expanding and perfecting the criteria.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT
A review of literature provided limited number of studies using eReaders. While the results of these studies do not provide a clear review regarding the effectiveness of eReaders, they do provide critical insights when viewed from the lens of the framework outlined above.

In this section, we develop hypotheses based on the above lens. We use the existing literature to substantiate our hypotheses. These hypotheses allow us to evaluate each of the dimensions of the eReaders rather than focusing on individual devices. Propositions based on these dimensions would be applicable across all eReaders, and thus more generalizable. Table 2 summarizes the studies, evaluates the technology used in terms of the dimensions and tabulates the results. These are discussed further below.

<table>
<thead>
<tr>
<th>Study and context</th>
<th>Classification based on the framework</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Martı´n, Estefanı´a &amp; Carro, R.. Supporting the Development of Mobile Adaptive Learning Environments: A Case Study. (2009)</td>
<td>Knowledge Integration-Student able to select and search information based on individual request. Collaboration-The main collaborative element of the tool was the ability to get names of other students taking the course who were also interested in a study group. Personalization-Students got study recommendations based on questions answered by student. Students were also able to take advantage of mobile learning when the internet was accessible.</td>
<td>The study used web-enabled devices such as PC, laptops and PDA’s. The study determined that students found mobile learning useful and they accepted this type of mobile learning.</td>
</tr>
</tbody>
</table>
gathered student’s specific recommendations for learning. This study was not specifically focused on eReaders, but does provide a path for future eReader design to follow.


Reading comprehension among university students was the focus of this study. A relationship between reading behaviors and test results was theorized. A web eBook that would give students study recommendations and tests every two weeks to validate knowledge retained was used to test this theory.


Perceptions and use of eBooks by facility at Arizona State University (ASU) were studied. This team used a trained focus group facilitator to talk to a small group of faculty.

Rowlands, I., Nicholas, D., Jamali, H. & Huntington, P. (2007). What do faculty and students really think about e-books?

This team received 1,818 responses from 27,000 surveys sent to faculty and students. This large scale online study survey set out to evaluate the use of eBooks among university students and faculty in the United Kingdom.

Knowledge Integration: Knowledge access through integration of textbooks to eReader devices has been the primary focus of much of the research. An analysis of existing research based on the framework suggests that knowledge integration is

<table>
<thead>
<tr>
<th>Knowledge Integration</th>
<th>Collaboration</th>
<th>Personalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textbook with problem solving questions incorporated for quick comprehension evaluation.</td>
<td>Within the web-based eBook learning system students could find the name of mentors and discussion forums.</td>
<td>Individual assessments at scheduled checkpoints resulted in customized recommendations on future course of study and materials to be used.</td>
</tr>
<tr>
<td>Web accessible books were convenient when available for use and with ample internet bandwidth.</td>
<td>Not available.</td>
<td>Limited to no customization perceived as available by the participants of the focus group.</td>
</tr>
<tr>
<td>Ease of use perceived as poor with respondents of survey stating that they printed the materials then treated as a traditional book. Thus not taking advantage of any electronic features.</td>
<td>No collaborative features specifically mentioned in this study.</td>
<td>No personalization mentioned in this study.</td>
</tr>
</tbody>
</table>

The study used web-enabled devices such as PC and laptops.
The study found that this web-based eBook significantly enhance student learning.
The group focused mostly on web-enabled eBooks including eBooks accessed through the University’s own library. They found the faculty to be generally unsatisfied with their eBook experiences. Reasons included the perceived steep learning curve, lack of manipulability and the unreliable access to web eBooks. An additional complaint noted was the lack of color on the eBooks.

Study included eBooks and eReaders with no mention of eReaders other than those accessible on PCs including web based eBooks and eBooks available from the library.

Responses to the survey showed 44% had used some form of eBook. Of the age groups studied the 17-21 year olds had a 48% preference to reading from a screen. When this team evaluated the kinds of eBooks that are being used by faculty and students they found that nearly 60% were textbooks.

Table 2. Literature review
Currently aimed at increasing the knowledge resources available on eReaders. A further analysis shows this has been a primary factor in enhancing the perception of the usefulness and ease of use of the eReaders (Rowlands et al. 2007). Interestingly, no evidence regarding its ability to enhance learning was present. Thus, we hypothesize

**H1: EReader devices that have a high level of knowledge integration will have a positive effect on perceived usefulness.**

Collaboration capabilities: The extensive literature in knowledge management has always emphasized the importance of collaboration in knowledge creation (Alavi et al. 2001). The two studies in our review also support this assertion. While both provided limited collaboration capabilities, ranging from finding names for study group (Martín et al. 2009) to accessing discussion boards (Chen et al. 2007), both studies provide evidence regarding the utility of collaboration tools in enhancing learning outcomes. Thus, we argue

**H2: EReader devices with high levels of collaboration capabilities lead to significantly higher levels of learning outcomes.**

Personalization: The importance of personalization is being extensively studied in contemporary research. In our literature review two studies used extensive customizations to model learning based on individual differences. The first study introduced adaptive learning (Martín et al. 2009) and the second study focused on reading comprehension (Chen et al. 2007). In both cases student satisfaction (an important learning outcome) was considerably increased. This is also consistent with the personalization and training literature which argues in favor of personalization to enhance knowledge retention. Based on this, we argue

**H3: EReader devices with high levels of personalization capabilities lead to significantly higher levels of student satisfaction.**

**RESULTS FROM A PILOT STUDY**

To test the hypotheses presented above a small action research based study was conducted. An eBook textbook was introduced in the graduate eBusiness strategy class. Out of the 24 students in the class, three students used the Sony Reader Touch 6, one student who used the Sony Reader also had a Kindle, four students used smart phones, and the rest used PCs. Observations were made throughout the course. We outline our experience and observations below.

Knowledge Integration: The Sony reader was able to read many different formats and this made it convenient to read the needed materials for the course in which the eReader was used. The team was required to read the course book that was in a PDF format as well as read student written chapters that were converted to txt, rtf or PDF. The Sony reader does not directly connect to the internet so using a PC was required to load this eReader with eBooks and any other materials needed for reading. Purchasing eBooks from the online Sony store was not as easy as purchasing a book from an online store such as Amazon.com, however, each of students did make purchases from the Sony Reader Store. The Sony reader has eInk display technology, which users reported made reading for extended periods of time easier than when compared to a computer screen or monitor. The students using the Sony reader found the selection of titles on the Sony Reader Store to be good but there was a limited selection of textbooks available. All the eReaders in the study did have a high level of knowledge integration and users felt positive about the perceived usefulness and for the most part the devices were perceived as easy to use.

Collaboration: The Sony reader offers the ability to borrow eBooks from libraries. However, the students in this study did not test this feature and did not find any other types of collaborative features worth noting in the Sony reader. With the exception of the PC/laptop/netbooks, eReaders have a limited ability to allow the user to collaborate. The only current collaboration features include checking out materials from a library with the Sony eReader and the Nook’s ability to share books with other Nook users. Because levels of collaboration are low, students are not experiencing higher levels of learning.

Personalization: The students were able to take notes in the margins of eBooks of the Sony reader. In addition to taking notes in the margins, the students were able to take notes on a separate notes section using a stylus that came with the Sony reader. A customization feature worth mentioning is the ability to change the size of the text being read in the Sony reader.

**CONCLUSION**

There has been little study to determine the usefulness of an eReader for Academia. Tools and conceptual frameworks to adequately evaluate the technology and hardware did not exist. This paper outlines one such framework. The use of our framework leads us to the following conclusions. While enhancing knowledge integration has been the primary focus of eReaders, this is not the dimension that we expect to have the most substantial impact on learning outcomes. A primary reason for this is that the current focus of eReader devices is not on integrating different knowledge resources, but only on
making them discretely available. It is clear though that knowledge integration enhances the perceived usefulness and perceived ease of use for the device. As technology adoption research has shown, these are the critical elements in adoption of technology (Lee et al. 2003).

However, as the discussion above shows, the critical component for enhancing learning using eReaders is their ability to enhance personalization and collaboration. However, as illustrated in Table 1 considerable potential for development exists here.

REFERENCES

5. Gupta, S., and Bostrom, R. "Theoretical model for investigating the impact of knowledge portals on different levels of knowledge processing," International Journal Of Knowledge and Learning (1:4) 2005, pp 287-304.
Using Virtual World Learning Environment as a Course Component in Both Distance Learning and Traditional Classroom: Implications for Technology Choice in Course Delivery

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Southern Polytechnic State University
chizhang@spsu.edu

ABSTRACT
This study examines and compares social presence perceived in a virtual world environment and students’ learning satisfaction in distance learning and traditional classroom settings. Our findings indicate that social presence is related to students’ learning satisfaction in both settings. The comparative analysis shows no significant difference between two classes in perceived social presence and overall learning experience. The results suggest that learning satisfaction is related with a variety of technologies used in the course delivery.

Keywords
Virtual World, Technology-mediated Learning, Second Life, Social Presence, Learning Satisfaction

INTRODUCTION
Three-dimensional (3-D) immersive virtual worlds are an emerging technology currently being used as education and research environments for academics (Harris, Lowendahl, and Zastrocky, 2007; NMC, 2008). Virtual worlds provide a unique environment and set of tools which students who have grown up using Information Communication Technology may find relevant and appealing. Theoretically Virtual worlds are “of particular pedagogical relevance because in such environments students are prone to explore, participate, discover new knowledge, and develop industry relevant skills with greater intrinsic motivation and autonomy” (Dreher et al. 2009, p. 212).

Second Life, a virtual world example, has been used and studied in both traditional classroom and distance learning. It was found that the integration of Second Life activities enhanced student learning satisfaction. Students considered the virtual world experience to be unique and interesting, however, problems of the use of Second Life are also reported (Shen and Eder, 2009; Wagner and Ip, 2009; Wang and Braman, 2009; Zhang and Zigurs, 2009).

We explored the role of virtual worlds in student interaction and learning satisfaction in an actual distance learning class (Zhang and Zigurs, 2009). We found that perceived social presence was correlated with perceived interaction, and the interaction was correlated with learning satisfaction. However, majority of the students reported their dissatisfaction with Second life. The reported difficulties encountered by students may have been strengthened by the nature of completely online courses where in-class training session is not available and students become frustrated with the technology. To further examine this phenomenon, this study intends to investigate the impact of learning settings on student perceptions of social presence and learning satisfaction by using Second Life in both traditional and distance learning classes.

Social Presence and Learning Satisfaction
In a learning context, social presence is defined as student perceptions of being in and belonging in an online course (Picciano 2002). In Tu and McIsaac (2002) study of the relationship of social presence and interaction in online classes, social presence was described as the degree of feeling, perception, and reaction of being connected by Computer-mediated Communication to another intellectual entity through a text-based encounter⁴ (p. 140). In technology-mediated learning research, studies have been conducted extensively to examine social presence and its relationship to learner satisfaction and learning outcomes.
Recent researches continued to study social presence and student learning experience with an emphasis on online courses. Cobb (2009) assessed social presence in online learning and found that students are satisfied with their experience in online courses. Homer, Plass, and Blake (2008) studied the general findings of the body of social presence research and learning. They found that when social presence is increased by the way of information is presented, learning process is perceived more engaging and learners remember the information better. These researchers, along with many others, demonstrated that most of the studies found that social presence is a critical factor in learning.

Social presence theory (Short, Williams, and Christie, 1976) views social presence as an attribute of the communication medium. Virtual world learning environments provide a highly social experience with multi-way interactions. A unique feature of virtual world environments is their resemblance of the real context relevant to learning objectives; therefore such environments can provide support for learning and enhance students’ learning satisfaction.

**RESEARCH METHOD**

Data were collected from two classes of the same course – a distance learning class in fall 2008 and a traditional class in fall 2009 at a Midwestern university in the United States. It was an introductory information systems course. 25 students enrolled in distance learning class and 13 out of 14 students who remained active at the end of the semester completed the survey. 58 students enrolled in traditional classroom class and 56 students responded to the survey questions. Table 1 and 2 show the demographic information of both classes.

<table>
<thead>
<tr>
<th></th>
<th>Distance Learning (N = 13)</th>
<th>Traditional Classroom (N = 56)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>76.9</td>
<td>92.9</td>
</tr>
<tr>
<td>Female</td>
<td>23.1</td>
<td>7.1</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-20</td>
<td>23.1</td>
<td>69.6</td>
</tr>
<tr>
<td>21-25</td>
<td>38.5</td>
<td>16.1</td>
</tr>
<tr>
<td>26-30</td>
<td>23.1</td>
<td>10.7</td>
</tr>
<tr>
<td>&gt;30</td>
<td>15.3</td>
<td>3.6</td>
</tr>
<tr>
<td>Year in School</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>7.7</td>
<td>37.5</td>
</tr>
<tr>
<td>Sophomore</td>
<td>23.1</td>
<td>30.4</td>
</tr>
<tr>
<td>Junior</td>
<td>23.1</td>
<td>17.9</td>
</tr>
<tr>
<td>Senior</td>
<td>23.1</td>
<td>3.6</td>
</tr>
<tr>
<td>Graduate</td>
<td>7.7</td>
<td>3.6</td>
</tr>
<tr>
<td>Other</td>
<td>15.3</td>
<td>7.1</td>
</tr>
</tbody>
</table>

**Table 1. Student Demographic Information in Two Classes**

<table>
<thead>
<tr>
<th></th>
<th>Distance Learning (N = 13)</th>
<th>Traditional Classroom (N = 56)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have had experience with Second Life or other virtual worlds</td>
<td>15.3</td>
<td>46.4</td>
</tr>
<tr>
<td>I have had experience with virtual world games</td>
<td>15.3</td>
<td>53.6</td>
</tr>
<tr>
<td>I have had experience with other online games</td>
<td>46.2</td>
<td>67.9</td>
</tr>
<tr>
<td>I have NO experience with Second Life or any other virtual worlds</td>
<td>23.1</td>
<td>10.7</td>
</tr>
</tbody>
</table>

**Table 2. Student Demographic Information in Two Classes – Online Experience**

**Procedure**

The researcher was the instructor for both classes. A variety of technologies were integrated into the course delivery. Second Life was used for student group project for both classes. The objective of the group project was to let student groups explore the presences of existing businesses in Second Life and investigate their business strategies of
making use of Second Life. Students were helped with tutorials, video links and in-class training session (for classroom section) to start their exploration in Second Life. The project took place over a period of six weeks.

Data Collection and Analysis

A post survey was given online and in class after the term group project for two classes. Responses were then manually entered into and analyzed with SPSS 14.0. The post survey contained demographic questions, Likert-scale questions of social presence and learning satisfaction, and open-ended questions about students’ opinions toward Second Life and their overall learning experience.

The social presence scale was adapted from Swan and Shih (2005) with minor modification, such as wording change from “online discussion” to “Second Life project,” intending to investigate student perceptions of social presence from this particular learning environment. The learning satisfaction scale has been validated and used in Chou and Liu (2005). The eight questionnaire items were adapted from previously validated scales (Alavi 1994; Compeau and Higgins 1995; Green 1980).

Results

Cronbach’s alpha was used to assess the internal consistency of the results across items within two scales. Table 3 and 4 show the reliability analysis results with descriptive statistics for both scales in two classes. Results showed that students perceived social presence in Second Life project to some extent and they were satisfied with learning experience in the course.

<table>
<thead>
<tr>
<th>Study Construct</th>
<th>Cronbach’s Alpha</th>
<th>Min</th>
<th>Max</th>
<th>Scale Range</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social presence</td>
<td>0.620</td>
<td>2.39</td>
<td>4.00</td>
<td>1 to 5</td>
<td>3.22</td>
<td>0.51</td>
</tr>
<tr>
<td>Learning satisfaction</td>
<td>0.811</td>
<td>1.69</td>
<td>2.69</td>
<td>1 to 5</td>
<td>2.13</td>
<td>0.28</td>
</tr>
</tbody>
</table>

Table 3. Reliability Analysis and Descriptive Statistics in Distance Learning Class (N = 13)

<table>
<thead>
<tr>
<th>Study Construct</th>
<th>Cronbach’s Alpha</th>
<th>Min</th>
<th>Max</th>
<th>Scale Range</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social presence</td>
<td>0.849</td>
<td>2.00</td>
<td>3.41</td>
<td>1 to 5</td>
<td>2.71</td>
<td>0.63</td>
</tr>
<tr>
<td>Learning satisfaction</td>
<td>0.910</td>
<td>1.95</td>
<td>2.50</td>
<td>1 to 5</td>
<td>2.29</td>
<td>0.61</td>
</tr>
</tbody>
</table>

Table 4. Reliability Analysis and Descriptive Statistics in Traditional Class (N = 56)

Pearson’s correlations analysis was conducted on social presence and learning satisfaction. Table 5 and 6 show that social presence yielded a correlation of 0.60 and 0.40 with learning satisfaction in distance learning and traditional classes ($r^2 = .51$ and .32 respectively). The results showed that social presence perceived from Second Life was correlated to students’ overall learning satisfaction.

<table>
<thead>
<tr>
<th>Class</th>
<th>Learning Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Presence</td>
<td>Distance Learning .597 (sig at .05 level)</td>
</tr>
<tr>
<td></td>
<td>Traditional .400 (sig at .01 level)</td>
</tr>
</tbody>
</table>

Table 5. Nonparametric Correlations Results

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Predictor</th>
<th>Class</th>
<th>R square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning satisfaction</td>
<td>Social Presence</td>
<td>Distance Learning</td>
<td>0.51</td>
<td>11.358</td>
<td>.006</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Traditional</td>
<td>0.32</td>
<td>25.041</td>
<td>.000</td>
</tr>
</tbody>
</table>

Table 6. Regression Analysis Results

The Wilcoxon-Mann-Whitney test was conducted to investigate the difference between student perceptions and demographic information in two classes. Table 7 shows no difference between gender distribution and online experience between the students in classes. However, the results showed that students in traditional class in this
study are younger, their class rankings are lower and they have more online experience. Nevertheless, there is no significant difference between social presence and learning satisfaction perceived by the students in two classes.

<table>
<thead>
<tr>
<th>Mann-Whitney U</th>
<th>Age</th>
<th>Gender</th>
<th>Class</th>
<th>Online Experience</th>
<th>Social presence</th>
<th>Learning satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>169.000</td>
<td>306.000</td>
<td>194.000</td>
<td>210.000</td>
<td>287.000</td>
<td>307.500</td>
</tr>
<tr>
<td>Wilcoxon W</td>
<td>1765.000</td>
<td>397.000</td>
<td>1790.000</td>
<td>1806.000</td>
<td>378.000</td>
<td>398.500</td>
</tr>
<tr>
<td>Z</td>
<td>-3.037</td>
<td>-1.702</td>
<td>-2.697</td>
<td>-305</td>
<td>-1.184</td>
<td>-0.871</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.002</td>
<td>.089</td>
<td>.007</td>
<td>.761</td>
<td>.236</td>
<td>.384</td>
</tr>
</tbody>
</table>

Table 7. Comparative Analysis between Distance Learning and Traditional Classes

**DISCUSSION**

Correlations analysis showed a significant relationship between students’ perceived social presence in Second Life and students’ perceived learning satisfaction. The comparative analysis results showed that learning settings was not a significant factor of student perceptions of overall learning satisfaction and social presence from virtual world activities. This result indicated that virtual world environment and the learning activities held in it played a bigger role in students’ learning experience as compared to whether virtual world training session was offered face to face and instructor’s assistance with the technology was instantly available. Learning curve is one of the factors that may affect the use of a technology but it is not a crucial one for virtual world environments.

Qualitative data collected from the students’ comments indicated that students related their learning satisfaction with other technologies used in the course delivery. More than half of the students commented that Second Life was a good idea for education but it had room to improve in terms of its clumsy interface design, the demanding system requirement, and its lack of participants on most of the islands. Students usually were not able to find any people to talk with on the business islands. This finding suggests that the integration of various technologies used in the course is important in students’ learning satisfaction.

**CONCLUSION**

Our findings suggest that students’ perception of social presence in the web-based virtual world learning environment contributes to their perceived learning satisfaction and so do other individual course activities. Students may not be satisfied with a particular technology adopted in the course delivery but if other learning tasks and technologies are designed and used well, the dissatisfaction does not hinder the overall learning experience.

The limitation of this study was the lack of randomization and manipulation in the study. Both classes in the study consisted of large proportion of male students. As this study used actual classes and the “participants belong to an intact group” (Richardson and Swan 2003), the randomization was beyond the researcher’s control which is the characteristic of experimental studies in an educational setting. The study design could have asked students to rate their learning satisfaction for just Second Life activities in addition to the overall learning experience. Social presence may be necessary to achieve high learning satisfaction but it may not be sufficient when other factors exist to reduce learning satisfaction.

The implications of this study extend into both research and practice. Instructors need to be aware of the impact of the technology adopted in the course and social presence or lack thereof may have on students’ learning satisfaction. More research needs to be conducted in the area of social presence for different course activities and information technologies used in the course and assessment of learning satisfaction at activity level. Research is needed to determine the criteria of technology choice from both instructor’s and students’ perspectives. The limited amount of empirical research in the area of virtual world learning environment and the lack of empirical research in social presence related to such environments make this study importance to the literature.

**REFERENCES**

UNIVERSITY PRIMARY APPRAISAL IN USER ADOPTION: AN EXPLORATORY CASE STUDY OF A TELEHEALTH PROJECT

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Terry College of Business, University of Georgia
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ABSTRACT
Implementation of a new system typically results in significant change for users’ work processes who engage in adaptation processes to cope with the change. Coping theory explains how people choose adaptation behaviors after a series of appraisal processes. Primary appraisal results in the categorization of the IT artifact as a threat or an opportunity. Understanding these primary appraisals, specifically what antecedents produce various appraisal results, allows better prediction of user behaviors and ultimately of implementation success. Drawing on observations during a case study of a telehealth pilot project in six sites, we offer a theoretical model to better understand the antecedents of primary appraisal.

Keywords
Coping, Appraisal, User Adaptation, Telehealth, Telemedicine

INTRODUCTION
A key component to the success of any situation that utilizes an IT artifact is the adoption of that artifact by the necessary users. The literature is ripe with streams of research attempting to understand the many facets involved in implementation success. Venkatesh et al. (2003) identify numerous variance models of user acceptance, including the technology acceptance model / unified theory of acceptance and use of technology (TAM/UTAUT) (Davis 1989), Theory of Planned Behavior (TPB) (Taylor & Todd 1995), and the Innovation Diffusion Theory (IDT) (Rogers 2003). As such, previous research has provided considerable insights into aspects of user adoption.

Beaudry and Pinsonneault (2005) provide a different theoretical lens by proposing the coping model of user adaptation (CMUA). By understanding that the new information technology constitutes a disruption to organizations, user adaptation can be viewed as coping (Beaudry & Pinsonneault 2005). The process of implementing a new information technology is fraught with questions about how the new artifact will fit into the existing process, what resources will be involved in the addition, which people will be performing which roles, etc. CMUA builds upon Lazarus and Folkman’s (1984) coping and appraisal model and applies it to a situation where the new information technology represents the stressor to be handled. Through a coping process, each user evaluates the situation through a series of cognitive appraisals and the outcomes of these appraisals determine the behaviors the user will engage in towards the implementation (Beaudry & Pinsonneault 2005). Understanding these appraisals, specifically what antecedents produce various appraisal results, allows better prediction of user behaviors and ultimately of implementation success.

The coping perspective provides a useful framework via which to examine adoption. Much is still unknown about how users make their appraisals of the situation during the coping process and the consequences of such appraisals. Lazarus and Folkman (1984) separate the appraisal process into primary and secondary pieces, and suggest the primary appraisal judges the stressor as a threat or an opportunity. They go on to suggest that a positive primary appraisal, a view that the impending change is an opportunity, leads to a higher quality of functioning and ability to draw upon and utilize resources than a negative appraisal. The benefits to understanding, and ultimately helping control primary appraisal, are high to businesses as they implement new IS projects. This study develops a theoretical model that integrates the work done so far in the coping arena with observations during a case study of a telehealth initiative to understand the antecedents to the users’ primary appraisal of a new information technology implementation.

The theoretical contribution of this paper is the development of a model with the factors assessed in primary appraisal of a new IT artifact. It begins by discussing the theoretical background of coping and the appraisal process. Next it describes the study of a telehealth initiative in rural nursing homes and offers preliminary findings that support or refine my primary appraisal model. We conclude with a brief discussion about the importance of further research and understanding of the components of the coping process for the area of user adoption.

THEORETICAL BACKGROUND
Coping
Coping is defined as “the cognitive and behavioral efforts exerted to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person” (Lazarus & Folkman 1984 p. 141). Cognitive efforts
involve distancing, escaping, acceptance, or other methods of altering the subjective meaning, while behavioral efforts include changing the situation (Folkman et al. 1986). In other words, coping is the process a subject takes in order to respond to a stressor that enters their environment. Beaudry and Pinsonneault (2005) explain coping as a response to a disruptive event that occurs in his or her environment (e.g., a new technology implementation.)

**Appraisals**

Appraisals are cognitive evaluations of the encounter, as the user categorizes the stressor (i.e., new IT implementation) and its various facets with respect to the user’s well-being (Lazarus & Folkman 1984; Beaudry & Pinsonneault 2005). Folkman and Lazarus (1988) go on to explain that the cognitive appraisal process mediates reactions and that each user will appraise a situation differently. They identify two types of appraisals that are of interest when studying the coping process: primary appraisals and secondary appraisals.

**Primary Appraisal**

Primary appraisal is a user’s assessment of the personal importance and relevance of the situation (Lazarus & Folkman 1984). The questions center around, “What is at stake for me in this situation?” (Beaudry & Pinsonneault 2005). There are two possible outcomes of the primary appraisal process: challenge or threat (Lazarus & Folkman 1984). Challenge refers to a situation that has been assessed as having positive outcomes for the user, and invokes emotions of excitement and anticipation. Some streams of literature refer to this outcome as an opportunity. To match the existing CMUA terminology and to avoid further confusion, we refer to this assessment as opportunity. Threats refer to a situation where loss or harm is anticipated and is categorized by emotions of fear, anger, and anxiety (Lazarus & Folkman 1984).

**Secondary Appraisal**

Users also undergo a second appraisal process, where resources are assessed that might allow management of the situation (Folkman et al. 1986). This is a complex process that takes into account coping options as well as their likelihood of accomplishing the desired results (Lazarus & Folkman 1984). In essence, this appraisal centers around the question of, “What is to be done about this situation?” Beaudry and Pinsonneault (2005) further explain that in the context of IT, secondary appraisal includes the components of work, self, and technology. Work control refers to the feeling of sufficient autonomy in regards to their job and ability to modify tasks, self control involves the users’ belief they can adapt themselves to the new environment, and technology control refers to the ability to manipulate features and functionalities of the new IT (Beaudry & Pinsonneault 2005).

**Dynamic Properties of Appraisal – Reappraisal and Triggers**

Lazarus and Folkman (1984) express some regret of the primary and secondary construct names, because these appraisals are dynamic in nature and not necessarily sequential in the coping process. Additionally, triggers in the user environment cause reappraisals of the situation, through updated primary and secondary appraisal mechanisms. Beaudry and Pinsonneault (2005) involve triggers in their CMUA development and suggest the adaptive behaviors (determined by initial primary and secondary appraisals) will result in a modified situation needing additional appraisals.

**Appraisal Results: Adaptation Behaviors**

Inside the coping process, the appraisal (and reappraisal) processes result in the selection of adaptation behaviors (Lazarus & Folkman 1984; Beaudry & Pinsonneault 2005). These adaptation behaviors directly affect implementation success. The resulting behaviors generally fall into either problem or emotion-focused coping solutions (Latack & Havlovic 1992). Beaudry and Pinsonneault (2005) define four adaptation behaviors inside CMUA, ensuing from the combination of the primary appraisal result (opportunity or threat) with the secondary appraisal (user control of the IS implementation). Benefit maximizing and benefit satisficing were derived from different secondary appraisals in conjunction with a primary appraisal as an opportunity, and resulted in individual efficiency and effectiveness pertaining to the IT implementation. Situations involving a primary appraisal result of threat included adaptation behaviors involving disturbance handling and self-preservation, and resulted in a variety of outcomes including failure (user exited the situation) and minimization of negative consequences (grudging acceptance.)

In another interpretation and categorization of adaptation behaviors, Piderit (2000) analyzes the research surrounding resistance as a response to change, and explains the complexity of both the dimensions (emotional, cognitive, and behavioral) and resulting combinations of user assessments. Appreciating the multidimensional aspect of appraisals, she calls on more research to interpret exit, voice, loyalty, and neglect as components of resistance which partly overlap with the adaptation behaviors described above. Only by understanding the coping process in greater detail will we be able to comprehend, predict, and influence the resulting adaptation behaviors and increase the probability of successful IS implementations.
The Coping-Adaptation model is shown in figure 1 as a pictorial representation of the framework described above, heavily influenced by Lazarus and Folkman (1984).

![Coping-Adaptation Model](image)

**Figure 1. Coping-Adaptation Model**

**METHODOLOGY**

Within this broader framework of coping-adaptation processes, my interest is in identifying determinants of primary appraisals. That is, what factors influence a user’s primary appraisal of a technology as a threat or an opportunity? To provide insights into this research question, we conducted a series of exploratory case studies. Case studies are an appropriate method to examine the phenomenon because there is little understanding of the primary appraisal process. Interviews allow us the freedom to investigate users’ beliefs and reactions surrounding the IT artifact and the intimacy of a case study allows us the focus to understand the nuances of the situation.

The context of the study is telehealth implementation in six rural nursing homes which have implemented or are in the process of implementing the technology. Use of the telemedicine unit is not mandated. As such, there is wide variation in the use of the telemedicine technology across the sites reflecting differing primary appraisals of the technology by stakeholders. This provides us with an excellent opportunity to gain insights into primary appraisals of the same technology in the same organizational context and the factors that lead to different outcomes.

**Case Study Context**

All six nursing homes are in rural areas and belong to the same parent organization. They have all been directed by the parent organization to implement telehealth units. Patient access to physicians (primary care, specialists, and emergency room) in rural areas is limited. Further, transporting the elderly to physicians or hospitals many miles away is inconvenient for the patients, costly, and may result in transport injuries. These factors formed the primary motivation for implementing these units in the nursing homes. All units are provided by the same not-for-profit organization that provides both the technology as well as the training to these sites.

Bashshur (1995) defines telemedicine as “a system of care that uses telecommunications and computer technology to substitute for face-to-face interaction between patients, physicians, and/or non-physician providers in various combinations.” The nursing homes are voluntarily using the telehealth units to connect to a well-known state hospital for patient emergency diagnosis, access to specialists that may not be able to visit their rural facility, and to connect with local attending physicians in their offices. Nurses and nursing home staff use a stationary presenting telehealth unit (a computer, with two monitors, speakers, a camera, and several medical scope peripherals) to connect to a physician at another site to conduct a medical consultation on the patient.

**Data Collection**

To date, 25 interviews have been conducted and the average interview lasted around an hour (detailed in Table 1.) The approximate interviewee participation time was 25 hrs and 33 minutes, and some stakeholders were interviewed multiple times. With one exception (permission to tape was denied due to unforeseen circumstances that had nothing to do with the interview), the interviews were audio recorded and transcribed. All subjects were assured confidentiality. The people interviewed were involved in the nursing home telehealth project at various stages of the implementation process, and had varying degrees of success with the voluntary usage of the telehealth units, with one nursing home discontinuing use. Details on the nursing homes are provided in Table 2. Each interview consisted of open-ended questions designed to better understand the appraisal process of the interview subject, as well as additional details about the telehealth implementation and reactions of other stakeholders.
Primary Appraisal as a Component of Telehealth Adoption

<table>
<thead>
<tr>
<th>Title and Position Description</th>
<th>Number of Interview Subjects (approximate time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursing Home Administrators – The top administrator at each nursing home facility</td>
<td>6 (6:21)</td>
</tr>
<tr>
<td>Director of Nursing – The head nurse at each nursing home facility</td>
<td>5 (5:40)</td>
</tr>
<tr>
<td>Additional Nurses &amp; Support Staff – Other nurses or counselors knowledgeable about the telehealth unit</td>
<td>4 (2:41)</td>
</tr>
<tr>
<td>Nursing Home Parent Company Administrator – Senior administrator of the parent organization that owns all nursing homes in the pilot project and is heavily involved with site selection for the telehealth project</td>
<td>1 (1:39)</td>
</tr>
<tr>
<td>Attending Physicians – Each is the medical director and heavily involved with multiple nursing homes in the pilot project</td>
<td>2 (4:22)</td>
</tr>
<tr>
<td>ER Physician – Primary contact at the well known state hospital being utilized for consultations</td>
<td>1 (1:42)</td>
</tr>
<tr>
<td>Telehealth Liasons- Employed by the not-for-profit organization responsible for supplying the telehealth units and training the involved parties</td>
<td>2 (2:38)</td>
</tr>
<tr>
<td>Telehealth Organization Administrator – Senior administrator of the not-for-profit organization responsible for supplying the telehealth units and training the involved parties</td>
<td>1 (0:30)</td>
</tr>
</tbody>
</table>

Table 1. Interview Details (multiple participants were involved in some interviews – hours represent each position’s collective involvement)

<table>
<thead>
<tr>
<th>Nursing Home</th>
<th>Number of Beds</th>
<th>Distance to Nearest E.R.</th>
<th>Telehealth Implementation</th>
<th>Current Status of Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>168</td>
<td>0 miles</td>
<td>January 2009</td>
<td>Implemented</td>
</tr>
<tr>
<td>B</td>
<td>50</td>
<td>13 miles</td>
<td>January 2009</td>
<td>Implemented</td>
</tr>
<tr>
<td>C</td>
<td>81</td>
<td>2 miles</td>
<td>January 2009</td>
<td>Implemented</td>
</tr>
<tr>
<td>D</td>
<td>104</td>
<td>0 miles</td>
<td>January 2009</td>
<td>Implemented</td>
</tr>
<tr>
<td>E</td>
<td>104</td>
<td>16 miles</td>
<td>January 2009</td>
<td>Discontinued (Oct 09)</td>
</tr>
<tr>
<td>F</td>
<td>59</td>
<td>17 miles</td>
<td>November 2009</td>
<td>In Process of Being Implemented</td>
</tr>
</tbody>
</table>

Table 2. Details of the Studied Nursing Homes

PRELIMINARY FINDINGS

While the term appraisal may conjure up the image of a conscious process, it is often that the individual may be unaware of any or all of the components of their appraisal (Lazarus & Folkman 1984). This was my impression of many of the people interviewed. Nevertheless, many insightful things were said that lend credibility to the proposed antecedents of primary appraisal.

Self-efficacy was a common theme when discussing concerns about the telehealth project. Two distinct types of self-efficacy surfaced: technology and process. Many people spoke about the technology skills needed, as seen in these responses:

Nurse B: The biggest drawback to me was using the computer. I’m not a computer person, so getting all that… I still don’t have all that down. I don’t think I could do it by myself if I had to.

Nursing Home Director E: That’s a complicated system when you get back there to fool with that. You’ve got to have some computer skills. Well, a lot of these nurses don’t have computer skills...[they were] scared to death.

However, concern with the other medical skills needed by the people using these telehealth units also emerged. An otoscope is a common medical instrument used to examine the ear, and although it is used in a telehealth consultation, the skills involved in using it go beyond simple use of the computer aspects of the telehealth technology.
Physician B: ...showing somebody how to hold the otoscope ...they’ve never looked in an ear before and now they’re asked...to put the otoscope in the ear. First you’ve got to tell them what an otoscope is, you know, and you’ve got to have somebody that shows you how to do it so that they don’t hurt the patient. It’s new skills for them. It’s more than just the computer, too, you know, it’s just new.

One physician, who was choosing not to participate in at least one component of the project, repeatedly cited his concern with the process because it involved a different physician giving a second opinion. In this instance, Physician A, viewed the use of telehealth as shifting the power to diagnose away from the attending physician.

Physician A: What the nursing home people presented to us...is...to do that before we send anybody to the emergency room. So instead of me making the decision, they wanted to get a second opinion from an ER physician who’s never seen the patient and see what he has to say before we send him. And if they say, “Yeah, send him,” then I guess we send him. If they say, “No, don’t send him,” when I suspect we [should send him], we kind of butt heads there. But that’s one of the big things that they wanted the attendings in the nursing homes to do, and I don’t do it that way.

One nursing home returned their telehealth unit after a prolonged period of disuse. Although their initial reactions were reported as positive, we were told that their opinion changed with the constant exposure to a doctor who was very negative about the project. We believe this is preliminary support for the construct of subjective norm affecting primary appraisal through a re-appraisal process (in this situation, the nurses went through iterations of reappraisals when exposed to the doctor.)

Nursing Home Director E: Well, I mean, [the nurses] had positive thinkings but they couldn’t...I mean, [the doctor] just didn’t want to hear anything about it. He didn’t want you to mention it to him.

Many conversations involved the perceived effectiveness of the telehealth consultations. While some opinions were positive and some were negative, the details were easy to classify as concerning the effectiveness of the technology to complete the task or the effectiveness of the new process surrounding the task. First, we see a physician’s negative perceptions about the new process effectiveness while the patient is still in the nursing home, which does not involve the technology in any way.

Physician A: I think I know my patients more than an ER physician does, so I have not used it for that.

Physician A: They don’t need to see the patient to decide if they need to see them or not. See what I mean? Guy’s got chest pain; he’s 33 years old. He supposedly drinks. His daddy died at 35—what do you think? Well, send him on down; we don’t need to see him on the telemedicine to do that....

Similarly, we encountered a nurse who believed very strongly in the effectiveness of the telehealth consultations. This belief centered around the new process of being able to immediately present a patient from inside the nursing home (i.e., without transporting) to a physician, and had nothing to do with the technology components of the consultations.

Nurse C: And also if you’ve got a patient and they’re having behavior problems it’s a really big issue. And it can be a scary issue. But with being able to present that patient you know that you can present him right away. That is a big difference, in my opinion....I think telemedicine has given me a comfort level.

However, perceptions about the effectiveness of the technology, devoid of concerns about the new process, were also presented. While previously expressing concerns about the new process effectiveness, Physician A also discussed benefits that the live video camera technology brought to increase the effectiveness of the consultation.

Physician A: It might be nice to have a live... “Well, pull it over this way, pull it over that way. Squish on it.” And do that kind of stuff, get a little bit better picture of it. And you might have a better quality of the transmission through the picture too. Anything visual is going to be nice. It would be good to have for anything that you have to really see.

Another physician believes that the technology improves the consultation experience, because of the ability to communicate via recorded video with the physician.

Physician B: Psychiatry is, if anything...it’s better. Because one of the problems you have is behaviors. You’re concerned about behaviors. You actually can video the patient and the behaviors you’re talking about, and let the psychiatrist watch the behaviors.

While these are only small snippets of the conversations with the stakeholders in the pilot project, they provide support for a set of preliminary constructs in the proposed primary appraisal model, seen in figure 2. These factors, encompassing both
personal and situational components, represent a preliminary set of antecedents that emerged from the interviews and that are used in the primary appraisal process that users undergo to determine if a new IT artifact is a threat or an opportunity.

CONCLUSION

While many technology acceptance theories exist, the coping process perspective offers a new way to understand how users arrive at their adaptation behaviors and can provide a useful framework for integrating adoption and resistance studies. By understanding the process, specifically the primary and secondary appraisals, businesses can more effectively encourage positive appraisals and reduce the occurrences of negative appraisals when introducing a new IT artifact. The current case study is a step towards theorizing a model of primary appraisal as a first step to better understanding the coping-adaptation process. The research model is only a first iteration of our attempt to better understand the primary appraisal process, and the current research is ongoing.

REFERENCES

ABSTRACT

Personal health information management (PHIM) refers to an individual’s use of various tools (i.e., email, paper, sticky notes, calendars, health portals) to manage their healthcare information (Jones 2008). With advances in technology, it becomes even more imperative that the healthcare community understand the factors that may influence consumers’ intentions to use various PHIM tools to manage his/her healthcare information. The Theory of Planned Behavior (TPB) and constructs from the Technology Acceptance Model (TAM), and the Computer Anxiety Rating Scale (CARS) guide this investigation into how consumers might use patient health portals to manage their healthcare information.

Keywords

TPB, TAM, C-TAM-TPB, Consumers, Healthcare IT, CARS

INTRODUCTION

In order to ensure that they receive the best care, health consumers today have to learn how to navigate an increasingly complex, often fragmented system of care distributed across different clinicians, specialists, and institutions. Moreover, health consumers are expected to have a better handle on their health information including medical histories, medications, and treatment in order to maximize consultations with their physicians and make more informed health decisions. In addition to personal health information (which can come in many forms: i.e., email, phone messages, mail, webpages from research, receipts, etc.), patients need to manage a slew of financial information related to healthcare such as insurance procedures, medical fees, and employee benefits.

Health consumers are aware of the complexity and sometimes challenging task of managing their healthcare information. For example, a college student is required to provide proof of immunizations and medical history for college enrollment. He/she may find that searching for such information is a challenge because they have to contact their physician(s) office to get this type of information. Sometimes this process may take a few days and can end up costing him/her money because some physician offices charge a fee for searching health consumer information. Managing health care information utilizing the physician office as the information portal is a common practice by health consumers today. Health consumers may also rely on information management strategies such as “just-at-hand” where documents are visible and readily available such as on top of a desk or night stand (Moen et al. 2005). Another strategy is “just-in-case” where the health consumer may store the document in a cabinet where they can find it within reasonable time (Moen et al. 2005). A viable solution for managing health information more efficiently is the use of the patient health portal. The patient health portal is defined as a secure healthcare information repository maintained by the health consumer and/or his/her physician. This repository may contain information about the consumers’ vaccinations, allergies, illness, medications, laboratory results, and any other medical information. The health consumer will have the capability to maintain his/her information and have the flexibility to access his/her health records anytime he/she chooses without the need to involve his/her physician for the information. The patient health portal also offers health consumers the ability to securely exchange messages (Weingart et al. 2006) with their physician. The flexibility and ease of use enables the consumer the ability to manage his/her own health information in an efficient and reliable manner.
Background

Today, there are an increasing number of patient health portals that are available to consumers. Some examples include Google Health, Microsoft HealthVault, WebMD, and many others, that provide the healthcare consumer the ability to manage their healthcare information. These patient health portals provide consumers the ability to store their medical information, track their medical history, and share medical information with their physician, to name a few. While there are a vast number of benefits to the use of the patient health portal, past research studies have focused on understanding the salient factors that influence the healthcare consumer to use technology to manage their health.

Current research findings illustrate that PHIM is an important area of consumer health informatics (Civan-Hartzler et al. 2006) with several barriers associated with the adoption of technology to manage health information. Much of the research has been focused on the technologies available for consumers to manage their healthcare information and barriers associated with the technology adoption. For example, these barriers may include information quality, security, and costs related to the use of technology to manage healthcare information. Information quality refers to how the information is presented to the consumer precisely and bias free (Civan-Hartzler et al. 2007). Security is another barrier that has been a topic of several research studies due to consumers’ fears and concerns of a breach or unauthorized access of their medical information. (Paul et al. 1999; Reich-Hale 1998). For example, a health consumer may store their medical information using Google Health. Two months from now, a security breach occurs at the Google headquarters and the consumers’ medical records are stolen. Such scenario is commonly attributed to the lagging effect of adoption of technology due to information security. The final barrier is the cost associated with the implementation of the technology. Often times, many studies have cited how the use of technology will provide the healthcare community with a reduction of administrative costs in healthcare treatment (England et al. 2007; Hsu et al. 2005; Kerr et al. 2008). Nevertheless, recent developments in technologies and the availability of new health portals, such as Google Health, provide healthcare consumers with a free service to manage their health information. While the health consumer has no direct cost associated with the adoption of health portals, stakeholders, including physician offices, insurers, and hospitals, may perceive the adoption of such technology as costly with limited benefits (Menachemi et al. 2004). Research on patient health portals have illustrated the benefits associated with the technology, but lack the fundamental understanding of how consumers’ affects impact to use it. Patient health portals offer unprecedented access to health information and services to the health consumer. Access to information when a health consumer needs it most is beneficial in situations such as natural disasters. For example, in 2005 hurricane Katrina destroyed parts of New Orleans and Mississippi. The destruction included homes, hospitals, and physician offices along with thousands of health consumers’ medical records. During a disaster such as hurricane Katrina, health consumers who use a health portal could benefit by having easy access to their health care information in a time of need. In contrast, health consumers who relied on their physician to manage their healthcare information may experience a greater challenge accessing their medical records. While there are many benefits to the use of the patient health portal to manage health care information, many health consumers have not fully embraced technology to manage their health care information. One reason consumers have not fully embraced the patient health portal could be due to computer anxiety.

Thatcher and Perwee (2002) stated that “computer anxiety refers to fears about the implications of computer use such as the loss of important data or fear of other possible mistakes.” Computer anxiety is classified as a state anxiety reaction because it is only experienced in specific situations. Anxiety has been defined as “a state of anticipatory apprehension over possible deleterious happenings” (Bandura 1997). The impact that computer anxiety may have on a health consumer is an area that has received little attention in past research. Therefore, this study will focus on impact that computer anxiety has as a moderator in the intention for health consumers to use the patient health portal to engage in PHIM. Furthermore, this study will utilize the TAM model in conjunction with the TPB and the CARS to measure the impact anxiety has as a moderator in the intention to use the patient health portal to engage in PHIM.

Technology adoption in healthcare has been a widely studied field today with the use of various theories and models as the theoretical models. These theoretical models include the Theory of Reasoned Action (TRA) in the study of behaviors and technology adoption (Elliott et al. 2008; Gee-Woo et al. 2005; Karahanna et al. 1999; Ortiz de Guine et al. 2009), and the Unified Theory of Acceptance and Use of Technology (UTAUT) to study factors that impact the intention to use technology (Venkatesh et al. 2003). While these theoretical models have been proven reliable in their areas of study, they were not fitting for this study. This study will focus on the salient factors of computer anxiety that influence the constructs of TAM and TPB in relation to consumers’ intentions to use technology. Therefore, this paper will identify the use of C-TAM-TPB model and how anxiety will impact the constructs identified in this model.
TAM has been widely used to better understand the intentions to use IT. The model has been used to study various fields including online consumers (Koufaris 2002), teachers (Gefen et al. 2003), training (Amoako-Gyampah et al. 2004), and consumer use of phone text services (Turel et al. 2007). Such studies have fundamentally proven that TAM can provide a variance averaging 40% or higher which is considered high compared to other models. In its form, TAM includes two constructs, Perceived Ease of Use and Perceived Usefulness. Perceived Usefulness may be defined as the level to which a consumer believes that a technology will increase their productivity (Davis 1989). Perceived Ease of Use may be defined as the level of difficulty to learn a particular technology (Davis 1989). Each of the constructs play a crucial role on identifying how consumers are likely to engage in a behavior that will lead to the intention and ultimately lead to the behavior. Much of the research has identified that once a consumer engages in a particular behavior, they are more likely to engage in the behavior. Therefore, identifying the variance between the constructs will provide a level of predictability by using this model.

While the use of TAM has been proven to have good predictability, this model alone may not be the best fit for consumer research. There have been many obstacles that have been presented before TAM. These obstacles include applying the model outside the workplace (Moon et al. 2001), and understanding external variables that influence a consumers decisions, such as social situations (Taylor et al. 1995). These obstacles have been addressed by the addition of external constructs that have helped TAM increase the variance and explain other factors that influence the intention to use IT. Some of the external constructs include Perceived Value (Turel et al. 2007), Perceived Risk (Im et al. 2008), Technology Ready Index (Walczuch et al. 2007), and Perceived Playfulness (Ahn et al. 2007), to name a few. These constructs have helped with the increased variance on the predictability by first identifying the salient factors to the area of study and then providing empirical evidence for the study. Yet, these studies do not provide the understanding of PHIM use among consumers. Furthermore, the use of TAM alone is not a fit for understanding consumer use of PHIM because the focus of study is their behavior and not a particular IT.

First proposed by Icek Ajzen in 1985, TPB has become a widely used theory in social sciences. TPB has been used to study exercise behaviors in older adults (Brenes et al. 1998), predict behaviors related to diets (Sparks et al. 1998), personal computer adoptions in the United States (Venkatesh et al. 2001), and the adoption of personal digital assistants (PDA) (Yi et al. 2006), to name a few. TPB focuses on 3 areas which have been found to guide human behavior. Figure 3 illustrates TPB. According to TPB, human behavior is guided by 3 considerations: 1) beliefs about the likely outcomes of a particular behavior, 2) beliefs about normative expectations from others, 3) belief of the presence of factors that impede the performance of a behavior (Ajzen 2006). TPB is an extension of TRA that includes the perceived behavioral control. With roots on Bandura’s (1977) research on self efficacy, TPB includes control beliefs that identifies how much control consumers have about a particular area of study (Jost et al. 1996). Self efficacy is an important part of this construct because according to Bandura (1977), consumers are more likely to try a behavior if they feel efficacious about that behavior. Therefore, if an individual has any anxiety about engaging in that behavior, they may be less likely to engage in that behavior. While TPB has been proven to have a high predictability, the theory lacks the usage intentions already posed by TAM (Taylor et al. 1995) in its original form.

Computer anxiety has been a widely studied field in the US. For this paper, computer anxiety is defined a consumers’ fear of interacting with a computer to engage in PHIM. Various studies have focused on the impact that computer experience (Wilfong 2006), internet use (Durnell et al. 2002), computer phobia (McIlroy et al. 2007), and computer training (Chou 2001), have on the anxiety consumers experience when using computers. The anxiety experienced from the intention to use the technology may have an impact on the self efficacy described by Bandura (1977), thus impacting the Perceived Behavioral Control of a consumer’s intention to use healthcare technology to engage in PHIM. Notwithstanding, that anxiety may have an impact on perceived behavioral control, this study will include the relationships that exist between anxiety and the impact it has on the constructs laid out in this model as a moderator.

PROPOSED STUDY

To better understand how consumers engage in PHIM, this study will use a theoretical model with the use of TPB and TAM constructs and the Computer Anxiety Rating Scale (CARS). This study will utilize validated question from TPB, TAM, and CARS. For example, a question from the CARS questionnaire “I look forward to using a computer” will be modified to “I look forward to using a computer to manage my healthcare information via the web portal?” in order to measure computer anxiety. Each question will be modified to include the use of a computer to engage in PHIM through a patient health portal. TPB has been selected because the purpose of this study is to identify how consumers manage healthcare information and determine the impact of computer anxiety as a moderator. Similar models have been proposed such as Decomposed TPB to better understand technology use (Huang et al. 2007; Taylor et al. 1995), Innovation Diffusion Theory (IDT) to study the adoption of personal digital assistants (PDA) (Yi et al. 2006), and Technology Adoption Model 3 (TAM3) to study the
determinants presented in the new model to study technology adoption (Venkatesh et al. 2008). Other studies include the use of Perceived Level of Satisfaction and TAM to understand how consumers accept technology (Wixom et al. 2005). Yet, these studies all have presented areas of research that include the use of TAM and TPB but lack the fundamental questions asked in this study and the impact that computer anxiety may have as a moderating variable for the C-TAM-TPB model. Figure 1 illustrates the proposed model. Below are the proposed research questions:

R1a: Does computer anxiety have an impact on a consumer’s Perceived Ease of Use toward computers to engage in PHIM?

R1b: What is the relationship between Perceived Ease of Use and the Intention to use computers to engage in PHIM?

R2a: Does computer anxiety have an impact on a consumers’ Perceived Usefulness toward computers to engage in PHIM?

R2b: What is the relationship between Perceived Usefulness and the Intention to use computers to engage in PHIM?

R3: What is the relationship between the subjective norms and behavior to use computers for PHIM and how does anxiety moderate the link between the two areas?

R4a: Does computer anxiety have an impact on perceived behavioral control toward a consumer’s use of computers to engage in PHIM?

R4b: What is the relationship between perceived behavioral control and use computers to engage in PHIM?

Figure 1. Proposed Theoretical Framework

PARTICIPANTS
Participants for this study will be recruited from Florida State University (FSU). The selected participants must be planning to enroll in at least one credit hour in the fall 2010 semester. The reason students were selected to participate in this research is because they represent a large portion of the young population in the United States. Furthermore, all students attending FSU are required to enroll in healthcare insurance. Their participation in an insurance program is the first requirement for the population in this study. The second requirement for this study will include access to any form of computer technology to engage in PHIM. Since a large portion of the students at FSU are enrolled with Blue Cross Blue Shield (BCBS) insurance, they are automatically have access to web tools for engaging in PHIM. Furthermore, students also have the ability to use other services such as Google Health to engage in PHIM, in situations where their insurer does not offer the service. All students selected to participate in this study must have access to a Web portal provided by their insurer or some form of computer technology that enables them to engage in PHIM. If they do not have access to a Web portal, they will not be considered for this study.

CONCLUSION
Understanding what influences the intention to use healthcare technology will provide valuable insight to some of the barriers that we face today in the adoption of healthcare IT. Understanding PHIM and the salient factors that attribute to the intention to engage in PHIM with or without the use of technology is valuable to the future development and adoptions of healthcare
IT. Similar to what other industries have adopted, such as the retail industry and banks, integrating what we know about consumers into the implementation of healthcare technology will help improve how consumers engage in PHIM. Furthermore, integrating other areas such as computer anxiety will further delineate some of the barriers that prevent consumers to go beyond paper to manage their healthcare information through a patient health portal.

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Web-based Disease Management: A Design Science Approach to Chronic Disease Management

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ABSTRACT
This research-in-progress presents a difficult healthcare problem, namely how to reduce the costs associated with chronic diseases. A comprehensive Web-based disease management system is proposed as a potential solution to help patients with chronic disease more effectively self-manage their disorders. A proposed research agenda is presented using a design science research approach. Theories capable of informing the design of the proposed solution are discussed including social learning theory and the theory of planned behavior. Design parameters are described and potential design ideas are presented.

Keywords
Disease management, design science, healthcare

INTRODUCTION
The World Wide Web has become an integral part of modern life with its uses in business, education, politics, entertainment, healthcare, and so much more that “an unavoidable fact is that the future of human society is now inextricably linked to the future of the Web” (Hendler, Shadbolt, Hall, Berners-Lee, and Weitzner 2008, p. 68). The Web’s connections to society and its exponential growth led Berners-Lee, Hall, Hendler, Shadbolt, and Weitzner (2006) to propose Web science, an interdisciplinary approach to studying and understanding the Web that includes the social as well as the technical. An implicit goal of the Web science discipline is for researchers to better understand and engineer the Web to produce desirable social phenomena in order to solve some of society’s most intractable problems.

One of those seemingly intractable problems is the effective delivery and management of healthcare. Total spending on healthcare in the United States for 2006 is estimated to have been $2.1 trillion or 16% of our gross domestic product, and based on current trends is projected to be $4.1 trillion by 2016 (Poisal, Truffer, Smith, Sisko, Cowan, Keehan, and Dickensheets 2007). This represents a considerable drain on both our national and individual economic resources. A substantial portion of these costs are due to complications with and exacerbations of chronic diseases like; heart disease, diabetes, asthma, and chronic obstructive pulmonary disorder. For example, the American Diabetes Association reports that there are currently 23.6 million people in the US with diabetes, nearly 8% of the population, and in 2007 the total annual economic cost of diabetes was estimated at $174 billion (ADA 2007). What makes chronic diseases, like diabetes, particularly important in the battle to curb healthcare costs is that much of the cost associated with chronic disease is preventable through lifestyle changes and the implementation and compliance with proper treatment plans. This means that patients with chronic disease need to effectively and consistently self-manage their disorders under the guidance of physician-based treatment regimens to reduce the potential for complications and exacerbations which are so costly.

In order to facilitate this process, the creation of disease management programs has been advocated and over the last couple of decades various types of these programs have been designed and implemented by healthcare organizations around the country (for a list of program providers see, DMAA 2009). The Disease Management Association of America (DMAA) defines disease management as “a system of coordinated health care interventions and communications for populations with conditions in which patient self-care efforts are significant” (Consensus 2003, p. 123). This is a relatively broad definition and therefore the specific ways in which these programs can be designed and implemented is quite varied. While there is general belief that disease management is effective, the myriad of ways in which these programs have been manifested makes it difficult to easily assess their value individually (Stone 2008). In addition, although “disease management programs have been shown to produce improvements in quality of care, … most of these interventions have been delivered in person and have therefore reached a relatively limited number of patients” (Espinet, Osmick, Ahmed, and Villagra 2005, p. 89). The question this raises is; are there better mechanisms for designing and implementing effective disease management programs that can potentially reach more individuals in ways that are more amenable to evaluation?

The World Wide Web is one possible answer to that question. The Web certainly makes it easier to reach more people in more places than ever before and the observation by Hendler et al. (2008) that the Web is capable of producing emergent
properties at the macro level suggests that a scalable Web-based disease management system could produce properties for self-managed disease care that are not possible with existing programs. Healthcare organizations, recognizing the potential value of the Web, have begun including it as a component in their disease management programs and several studies have been conducted on the value of Web-based disease management systems. Dubey (2003) designed and implemented a Web-based diabetes disease management system for use by clinicians at the point of care to improve data collection related to diabetes management. Meigs, Cagliero, Dubey, Murphy-Sheeby, Gildesgame, Chueh, Barry, Singer, and Nathan (2003) tested a clinical decision support tool for diabetes disease management and found that the system improved several evidence-based processes of diabetes care. Many other disease management programs use the Web in various ways, but a scalable comprehensive Web-based disease management system that incorporates all components suggested by the DMAA to constitute a full-service disease management system has not yet been build and evaluated. It is suggested that such a system that can fully leverage the Web’s unique characteristics and capacities could be effective in reaching a larger percentage of the population that would benefit from disease management interventions.

**Research Objectives**

The specific objectives for the proposed research are as follows:

- Build and implement a comprehensive Web-based disease management system in conjunction with a specific healthcare organization.
- Build system architectures and applications for scalability to facilitate potential macro level Web-related emergent properties.
- Evaluate the effectiveness of the system through available metrics for disease management programs and compare these results to other existing programs.

March and Smith suggest that, “design science attempts to create things that serve human purposes. It is technology-oriented. Its products are assessed against criteria of value or utility – does it work? is it an improvement?” (1995, p. 253). They go on to state that, “design science consists of two basic activities, build and evaluate” (March and Smith 1995, p. 254). The objectives for this research, focused on the activities of building and evaluating, constitute the primary activities of design science as defined by March and Smith (1995) and place this work within the design science approach to research.

Vaishnavi and Kuechler (2008) identify five potential outputs of design science; *constructs* (the conceptual vocabulary of a domain), *models* (a set of propositions or statements expressing relationships between constructs), *methods* (a set of steps used to perform a task – how-to knowledge), *instantiations* (the operationalization of constructs, models, and methods), and better theories (artifact construction as analogous to experimental natural science). The Web-based disease management system that is the proposed output of this research constitutes an instantiation of design science research.

**THEORETICAL BACKGROUND**

Disease management programs focus primarily on behavior-based interventions. Therefore, theories of psychology are particularly relevant to the development of an effective disease management system.

Social learning theory (Bandura 1971) has relevance for the design of disease management systems. Social learning theory suggests that people learn by observing and modeling the behaviors of others. The likelihood that observed behaviors will be enacted is related to the self-efficacy (i.e. self-confidence towards learning) of the individual. Individuals suffering from a chronic disease often begin treatment with a low self-efficacy in regard to their ability to self-manage their disorder. This makes it important to incorporate mechanisms that facilitate increased self-efficacy and adequate opportunities for observing appropriate behavior that can subsequently be modeled. Lieberman (2001) found that computer games designed to teach adolescents self-management skills of chronic conditions were effective in facilitating self-management behaviors by increasing self-efficacy toward those behaviors. For a Web-based system, in addition to self-efficacy toward self-management behaviors, it will also be necessary to take into consideration computer self-efficacy issues.

The theory of planned behavior (TPB) (Ajzen 1991) can also inform the design of disease management systems. TPB posits that human behavior is determined by the combination of: attitude toward the behavior, subjective norm, and perceived behavioral control. Interventions designed to change behavior can be directed at one or more of these determinants. This would suggest that disease management systems should be constructed to facilitate positive attitudes toward self-management behaviors, include family and other important referents in intervention strategies, and make it clear that the patient is in charge of his/her own disease management and capable of performing self-management tasks. Theories of motivation also have significant relevance to the design of disease management systems. Self-determination theory (SDT) is one theory of motivation that has been used in relation to disease management programs. SDT posits that, “human motivation requires a
consideration of innate psychological needs for competence, autonomy, and relatedness” (Deci and Ryan 2000, p. 227). Sheldon, Williams, and Joiner suggest that SDT is “perfectly tailored for clinical settings, because it focuses not only on how people in positions of knowledge and influence can best motivate their clients but also on how authorities may sometimes unintentionally undermine their clients’ motivation” (2003, p. vii). An SDT process model was used by Williams, McGregor, Zeldman, Freedman, and Deci to study glycemic control in diabetes self-management and found that “self-management behaviors mediated the relation between change in perceived competence and change in glycemic control” (2004, p. 58).

Other relevant theories for disease management include social cognitive theory (SCT), common sense self-regulation model (CS-SRM), operant learning theory (OLT), and implementation intention (II). Eccles, Grimshaw, Johnston, Steen, Pitts, Thomas, Glidewell, Maclennan, Bonetti, and Walker (2007) combined constructs from these theories along with constructs from TPB in a study of the management of upper respiratory tract infections. In predicting behaviors, they found that the explained variance was proportioned at: 31% for TPB, 26% for SCT, 6% for II, and 24% for OLT.

Having an understanding of these theories and applying them in the design process can facilitate the development of a disease management system that complements and enhances the treatment regimens of physicians for self-management of chronic diseases.

BUILD

The build stage centers on the creation of an IT artifact to appropriately address the identified problem; in this case, the lack of substantial gains in the overall reduction of complications and exacerbations of chronic diseases and their associated costs using existing disease management programs. A comprehensive Web-based disease management system that can fully leverage the Web’s unique characteristics and capacities is proposed as a potential solution to this problem.

A starting point for designing the various components and modules that would make up the proposed system would come from DMAA specifications for disease management program components. The following list of components is required for a disease management program to be considered full-service as opposed to merely a support service (Consensus 2003): (1) population identification processes; (2) evidence-based practice guidelines; (3) collaborative practice models to include physician and support-service providers; (4) patient self-management education (may include primary prevention, behavior modification programs, and compliance/surveillance); (5) process and outcomes measurement, evaluation, and management; and (6) routine reporting/feedback loop (may include communication with patient, physician, health plan and ancillary providers, and practice profiling).

Each of these components is addressed below with proposed design ideas.

Population identification processes: It is estimated that 24% of the 23.6 million people in the US with diabetes are currently undiagnosed (ADA 2007). This component, leveraging Web capabilities, would incorporate mechanisms for identifying undiagnosed as well as at-risk individuals in the general population. Novel methods to encourage participation in conjunction with online screening tests and customized links to treatment resources would facilitate this process.

Evidence-based practice guidelines: Methodologies have been proposed for evidence-based disease management guidelines (Ellrodt, Cook, Lee, Cho, Hunt, and Weingarten 1997) which could be used to guide the design and development of the portions of the system relating to this component. System design for this component would focus on facilitating the implementation and achievement of these guidelines in practice in novel ways.

Collaborative practice models: Collaborative practice models emphasize joint decision-making between a patient and clinicians. Disease management typically involves an interdiscipli nary team of clinicians to develop and guide effective disease management treatments. Therefore, the design of system mechanisms to support this component would incorporate existing collaborative Web tools as well as the development of novel methods of facilitating effective collaboration between patients and clinicians. In addition, there are a limited number of clinicians for a growing number of patients so the design of tools that allow for more efficient collaboration will be particularly important.

Patient self-management education: There are a number of mechanisms for facilitating patient self-management of chronic diseases including informational resources, support groups, and incentive programs along with standard physician directed primary prevention and structured behavior modification programs.

A substantial amount of information about disease management is currently available on the Web, but lacks a mechanism for adequately distilling that information for effective use. Here semantic web tools, proposed by Berners-Lee, Hender, and Lassila (2001) as the next generation of Web technology, could be leveraged to provide patients with a highly customizable resource and information space to better inform them about their condition and provide recommendations on effective
methods for self-management of chronic diseases.

Support groups are another useful tool for encouraging appropriate disease management practices and sustaining those practices over time. Zrebiec and Jacobson (2001) found that a professionally moderated Internet diabetes discussion group was actively used by a wide audience and may be an effective method for providing information and support about the disease. Collaborative Web tools could again be leveraged to facilitate more effective online support and discussion groups for disease management.

Incentives are another potentially useful mechanism for encouraging and sustaining appropriate disease management practices. A team of MIT students is currently testing an incentive system for TB medication compliance in Nicaragua that rewards compliance with cell phone minutes (Trafton 2008). This is just one example of how technology could be combined with incentives to improve compliance with treatment plans. Roter, Hall, Merisca, Nordstrom, Crelin, and Svarstad (1998) conducted a meta-analysis of intervention studies to improve patient compliance with medical regimens and found that no single strategy showed a clear advantage, but comprehensive interventions were more effective than single-focus interventions. This would suggest that an intervention component to the proposed system should be multi-faceted and customizable to individuals needs.

Process and outcomes measurement, evaluation, and management: Existing metrics described in the evaluation section below would be used for process management and outcome evaluation. In addition, novel mechanisms developed for other components of the system may require the creation of new metrics to appropriately assess their effectiveness.

Routine reporting/feedback loop: In this component a variety of customizable communication tools would be necessary to facilitate communication between the patient, physician, other clinicians, the health plan and ancillary providers.

The second research objective of building scalability into the system’s architectures and applications is a direct response to the suggestion by Hendler et al. (2008) that emergent properties of Web-based applications often occur at the macro level which cannot be easily predicted by analyzing technical and/or social effects on the micro scale. Building for scalability and encouraging expansion could result in useful emergent properties for disease management. For example, it may be that an effective incentives program would emerge at a macro level that was not viable at the micro level.

EVALUATION

An evaluation of the proposed Web-based disease management system could be fulfilled using established metrics. In 2003, the American Healthways and Johns Hopkins Consensus Conference was convened to develop both a set of metrics and a uniform methodology for the evaluation and comparison of disease management programs (Consensus 2003). The methodology proposed included recommendations for components of study design, implementation, evaluation, and analysis. Specific metrics for each disease were established including; biological indicators (e.g. LDL level at target), exam intervals (e.g. dilated retinal exam), and behavioral metrics (e.g. smoking quit rate) that could be used to assess program success.

The DMAA has more recently produced a set of guidelines for measuring disease management outcomes that could also be used for evaluating the proposed system (Market-Wire 2007). These guidelines continue to be updated annually so may better serve as a current best set of metrics for evaluating disease management programs.

In addition to these metrics designed specifically for disease management, Dzewaltowski, Glasgow, Klesges, Estabrooks, and Brock (2004) have developed the RE-AIM framework for use in evidenced-based behavioral medicine. RE-AIM, “emphasizes results along the dimensions of reach; effectiveness (including impact on quality of life and potential negative outcomes); adoption (by representative settings and clinicians); implementation consistency by various staff; and maintenance at both the patient and the setting level” (Glasgow, Nelson, Strycker, and King 2006, p. 68). Because disease management is very much a behavioral oriented practice, the RE-AIM framework could provide an additional set of metrics for evaluating the proposed system.

Based on the existence of established metrics for the evaluation of disease management systems, the “Using Metrics” research pattern (Vaishnavi and Kuechler 2008) will be adopted as the evaluation method for the proposed system. The exact methodology used to apply these metrics would depend on the implementation setting. Appropriate evaluation models might include; time trend analysis, a multiple baseline design, or a regression-discontinuity design. Because the proposed system is being implemented and evaluated in a live environment there are likely to be events that impact outcomes in the target population that are unrelated to the disease management program. It will therefore be necessary to identify any potential environmental factors that may be an influence on the disease management outcomes and include those factors in the discussion of project results.
Design Research Guidelines

Hevner, March, Park, and Ram (2004) proposed seven guidelines for design science research. This proposal is evaluated against those guidelines as follows:

- **Design as an Artifact**: The proposed Web-based disease management system constitutes an instantiation of “a purposeful IT artifact created to address an important organizational problem” (Hevner et al. 2004, p. 82).

- **Problem Relevance**: The proposed Web-based system is designed to facilitate improvement in the management of chronic disease; medical conditions which currently result in billions of dollars in US healthcare costs. According to the National Center for Health Statistics, patients with one or more chronic conditions accounted for fully 50% of the visits to physician offices in 2006 (NCHS 2008).

- **Design Evaluation**: The system will be evaluated against established metrics for disease management and behavioral medicine. The results will be compared to the performance of other disease management programs to determine improvements in effectiveness over existing solutions.

- **Research Contribution**: The Web-based disease management system as a design science research artifact will be the primary contribution as a “solution of heretofore unsolved problems” (Hevner et al. 2004, p. 87). The proposed research would also contribute to the knowledge base of both the information systems and web science disciplines by adding to our understanding of how the World Wide Web can be engineered and leveraged to produce desirable social change. The contribution to practice would be an improvement in the ongoing treatment of chronic diseases with potential cost savings that could be redirected to other healthcare needs.

- **Research Rigor**: Design and construction of the proposed system will utilize patterns suggested by Vaishnavi and Kuechler (2008) and follow best practices for systems development. Evaluation will be based on established metrics for disease management outcomes.

- **Design as a Search Process**: The general design cycle described by Vaishnavi and Kuechler (2008) with its emphasis on iterative circumscription along with their suggested patterns promotes a step by step process of searching for and designing a more effective artifact and the iterative cycles this process typically requires.

- **Communication of Research**: Communication with researchers and practitioners in both the information systems and medical fields will be accomplished through conference/journal publication.

**CONCLUSION**

This research, while ambitious in scope, has the potential to significantly change the way chronic disease is managed and controlled. The design and evaluation of a comprehensive Web-based disease management system will be a significant contribution to research in both the information systems and healthcare fields. Results of the design process may also add to our understanding of the ways in which the Web can produce emergent properties not evidenced in current systems.

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THE IT-PRODUCTIVITY LINKAGE AT THE COUNTRY LEVEL FOR DEVELOPING ECONOMIES

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ABSTRACT

Recent evidence suggests that information technology (IT) investments have a positive impact on productivity and economic growth for developed countries. However, for developing countries, the relationship between IT investment and economic growth remains unclear. This paper draws on the resource-based view (RBV) theory with its notion of resource complementarity to propose a theoretical model of how factors interact with IT investment to influence economic productivity. The proposed model posits a number of factors affecting the productivity of IT investment in developing economies.

Keywords

Productivity paradox, information technology, resource-based view theory

INTRODUCTION

As organizations become increasingly dependent on information and communication technologies (ICT), increasingly larger percentages of capital investment are being devoted to these technologies. For example, aggregate U.S. data shows that ICT capital investment as a share of total capital investment has increased from 3.5% in 1980 to 9% in 1990 and to 33% in 2000. Given the magnitude of ICT investment, it is essential for economies, particularly developing economies, that these investments produce the desired benefits.

This research is concerned with the relationship between IT investments and macroeconomic productivity, a research stream that was triggered by the 1970s productivity slowdown in the U.S. that coincided with a surge in IT spending. In contrast to the conventional wisdom, US based studies conducted a decade or more after the surge, in the late 1980s and early 1990s, failed to find evidence that ICT investments improved productivity (e.g., Roach, 1989, 1991; Oliner and Sichel, 1994). This failure to find evidence supporting a significant positive relationship between ICT investment and macroeconomic performance was so prevalent that it became known as the productivity paradox. The paradox was attributed to the fact that ICT capital expenditures, at the time less than 10% of total capital expenditures (Dedrick, Gurbaxani, Kraemer, 2003), a much smaller share of total capital stock than it is today, seemed to have little or no impact on macroeconomic productivity (Brynjolfsson, 1993; Sichel, 1997). More recent studies, however, have found a significant positive relationship between ICT investment and macroeconomic productivity at least for developed economies (Dewan and Kaeramer 1998; Jorgenson and Stiroh, 2000).

While recent studies of developed economies have demonstrated a significant positive relationship between ICT investment and macroeconomic productivity, suggesting that the productivity paradox is no longer an issue for developed countries, it remains an issue of deep concern for developing economies where the data still fails to show a positive significant relationship between ICT investment and economic productivity (Dewan and Kaeramer, 2000). Despite this lack of evidence, the assumption that developing countries can achieve high rates of economic growth by investing heavily in ICT is widely held by institutions such as the World Bank, International Telecommunications Union (ITU), and International Monetary Fund (IMF). In other words, if developing economies are going to narrow the economic gap, they must make more productive use of ICT than developed countries. Thus, achieving this outcome is of paramount importance to policy makers for both developing countries and international economic development funds.

Despite the obvious need, there is a lack of knowledge of the mechanisms and factors affecting the economic productivity of ICT investment. The current research contributes to this void by (1) delineating the factors that influence the ICT-economic productivity relationship at the macroeconomic country level and (2) proposing a model of how these factors interact with ICT to influence macroeconomic productivity. The relationships posited by the model provide a foundation for empirical studies and, once verified, relationships in the model can provide policy makers in developing countries and funding institutions with a better understanding of how various contextual factors impact the macroeconomic productivity of ICT investments thereby providing developing economies with a roadmap to increase the productivity of their ICT investments and narrow the gap between their economies and those of the developed world.
Next the paper reviews and synthesizes the literature on the ICT-macroeconomic productivity. This is followed by the introduction of the resource-based view (RBV) theory and development of a series of related hypotheses. The final section presents a summary and directions for future research.

BACKGROUND

At the individual firm level, the value of IT is one of the most researched topics within the computing literatures. Numerous studies have demonstrated the contributions of IT investments to a host of firm-level outcomes, including productivity (Lichtenberg, 1995; Brynjolfsson and Hitt, 1996), business performance (Chan et al., 1997; Bharadwaj, 2000; Sabherwal and Chan, 2001), and competitive position (Sethi and King, 1994; Powell and Deant-Micallef 1997). While the focus of the current work is the linkage between IT investment and macroeconomic productivity, the relationship between IT and firm-level performance and competitive advantage will be delineated to provide a more complete picture of the research including identifying some of the theoretical underpinnings of IT-productivity research.

IT and Firm-Level Performance

A review of the research on the relationship between IT investment and firm-level performance reveals two contrasting schools of thought. The first school of thought, dominant until the early 1990’s, took a myopic view of the relationship between performance and IT investments. According to this school, IT investments confer sustainable performance and create competitive advantage through perpetual innovation and early IT adoption (Porter, 1985; Clemons, 1986). However, recent (early 1990s to date) evidence indicates that IT investments alone do not produce sustainable competitive advantages nor do they result in superior performance (Clemons and Row, 1991; Kettinger et al., 1994).

Clemons and Row (1991) and Kettinger et al. (1994) identify several reasons for differences in findings. In addition to methodology and sampling flaws, the pervasiveness of IT, the relative ease of acquiring IT in competitive markets, and the ease of imitating and duplicating IT resources have all been cited as possible reasons why IT alone has failed to show a measurable positive contribution to superior economic performance and sustainable competitive advantage. Another explanation, which is of special importance to this research, is offered by the resource-based view (RBV) theory, which was introduced into information systems research by Barney (1991). According to the RBV theory, firms hold heterogeneous resource portfolios—whether by history, accident, or design—and that this resource heterogeneity is responsible for observed variability in financial returns across firms (Peteraf, 1993; Powell and Deant-Micallef, 1997). Combining the empirical evidence from the post-1990s studies of ICT macroeconomic performance with the logic of the RBV theory produces a new paradigm. According to this perspective, organizations cannot expect IT alone to produce sustainable performance and/or competitive advantage. Rather, it is how organizations use their IT resources to leverage and exploit preexisting complementary resources that enables or inhibits superior performance and competitive advantage. As we shall see below, the work presented here draws on the RBV theory as a foundation for explaining the difference in ICT macroeconomic productivity and growth between developed and developing countries.

ICT and Productivity

Over the past three decades, much research has investigated the influence of IT investments on productivity. A review of the IT-productivity literature reveals that the relationship between IT investment and productivity has been researched at three major levels: the country level (e.g., Roach, 1989; Dewan and Kraemer 1998; Dewan and Kraemer 2000), the industry level (e.g., Jorgenson and Stiroh 2000), and the firm level (e.g. Lichtenberg, 1995; Brynjolfsson and Hitt, 1996; Dewan and Min, 1997). Due to space limitations and because the current research is concerned with understanding the IT-productivity link at the macroeconomic level, only select material from the national macroeconomic literature will be reviewed here. A comprehensive review of all three levels can be found in Dedrick et al, (2003).

As stated earlier, contrary to the conventional wisdom that investment in IT leads to higher productivity, studies conducted in the late 1980s and early 1990s failed to find evidence supporting this relationship (Roach, 1989; Oliner and Sichel, 1994; Jorgenson and Stiroh, 1995). The lack of evidence soon became known as the productivity paradox; that is, results failing to show that spending on IT increased macroeconomic productivity, or as Robert Solow, the Nobel Laureate, stated, “the computer age is everywhere but in the productivity statistics”. Brynjolfsson (1993) attributed these perplexing results to the then small share of the economy that IT represented, an explanation echoed by Sichel (1997) who contended that IT capital stock was too small a portion of the total capital stock to have a substantial impact. At the time, aggregate US ICT capital investments as a share of total capital investment was less than 10% (Dedrick et al., 2003).

Since then, US ICT capital investment as percentage of total capital investment has grown dramatically. Recent studies have found that US ICT investments have shown a positive effect on productivity and economic growth (Jorgenson and Stiroh,
Examine aggregate data across 17 developed countries over the period 1985-1992, Dewan and Kaeramer (1998) found that these economies were earning a positive and significant return on their IT investments, concluding that “IT investments are contributing to output and productivity at a rate that is disproportionate to their factor share in production” (p. 61). Schreyer (1999) examined IT’s contribution to productivity and economic growth for the G-7 countries during the period 1990–1996. He too found that IT made a positive contribution to productivity and economic growth in all of the G-7 countries over the years studied. These studies provide strong evidence that IT capital is now contributing to productivity and growth in developed countries which renders the productivity paradox as non issue in developed countries. Collectively these and earlier studies also suggest that the productivity paradox may exist until ICT capital investment as a share of total capital investment approaches 33% as it did in 2000 in the US. This does not bode well for developing economies depending on investment in IT to improve productivity.

In addition to dispelling the productivity paradox, finding a positive and significant return on ICT capital investments for developed countries, Dewan and Kaeramer’s (1998, 2000) found that non-ICT capital investments were not commensurate with their share of total capital investment. Interestingly, they also found that the situation reversed for the developing countries in their studies, where the developing economies earned a significant return on their non-ICT capital but investments in ICT failed to show a return on investment - an indication of the existence of productivity paradox in developing countries. Two possible explanations were advanced as to why ICT failed to increase productivity in developing countries. First, the insignificance of ICT contributions is attributed to the lack of resource complementarity, with the authors noting that “compared to the advanced countries, less developed countries have poorer infrastructure, inherently less productive human capital (in part due to lower levels of education) and business models that have yet to transition from the industrial to the information age” (Dewan and Kaeramer, 2000, p. 561). In other words, countries, organizations, and individuals must acquire and accumulate a certain level of experience with technologies before they become proficient and investments in IT capital start to earn a return. A related explanation is the relatively low level of IT capital stock in developing countries to have a substantial economic impact – the situation that existed in developed countries until the 1990s.

Collectively these studies indicate that when IT capital investments approach 1/3 of total capital investments in developed countries, ICT investments have a major impact on labor productivity and economic growth. However, prior to reaching this threshold of about 1/3 of total capital investment, investments in ICT fail to impact labor productivity and economic growth. This is particularly problematic for developing countries; countries desperate to improve labor productivity to enhance economic growth.

While structural reasons such as the investment threshold have now been identified, other factors contributing to the effectiveness of ICT investments remain unknown. For example, the regression model proposed in Dewan and (2000), which was derived from the Cobb–Douglas production function, does not include any of the resources that may complement labor and ICT capital to improve productive. In fact, there currently exists no theoretical model that explains the inner working of the ICT-productivity linkage at the country level in terms of how ICT investments affect productivity and what other factors influence the relationship and in what way. The next section proposes a model of how factors interact with IT investment to influence country-level productivity using the resource based view (RBV) theory.

**THEORETICAL LENS AND HYPOTHESES DEVELOPMENT**

The resource-based view (RBV) is a robust theory that has received wide acceptance in strategic management and information systems research. Although built to investigate firm-level performance, the RBV theory with its resource complementarily notion would seem to provide a solid theoretical foundation for investigating factors that can improve ICT productivity at the country level. At the firm level, the RBV theory postulates that firms hold heterogeneous resources portfolios- whether by history, accident, or design- and that this resource heterogeneity is responsible for observed variability in financial returns across firms (Peteraf, 1993; Powell and Dent-Micalef, 1997). Within the context of IT, the logic of the RBV theory asserts that firms cannot expect IT to produce sustainable performance or competitive advantage alone. Rather, it is how firms use their IT resources in concert with other complementary resources that enables or constrains economic performance. Extrapolating to the country-level, the RBV theory would suggest that country-level returns on ICT investments are dependent on how countries use these investments to leverage and exploit preexisting complementary
resources. This notion of the resource complementarity, the foundation of the RBV theory, was expressed in Dewan and Kaeramer (1998) when they wrote:

How can we explain these high returns from IT investment in developed countries? A potential explanation is that the estimated returns from IT investment reflect other changes in the economies of developed countries that are complementary to IT investments, such as infrastructure, human capital, and informatization of business processes. In other words, the positive returns are not only due to increases in IT capital per worker, but also reflect simultaneous changes in education, infrastructure and other factors that complement labor and make it more productive.

Combining the empirical evidence with the RBV as a theoretical foundation, the following two competing propositions can be posited:

\( H1a \): IT capital investment influences economic productivity both directly and indirectly through interaction with non-IT capital investments.

\( H1b \): IT capital investment influences productivity only indirectly through interaction with non-IT capital.

Research has suggested a number of factors that may affect the relationship between IT capital and productivity at the country level. Examples of these factors include knowledge capital, informatization of business processes, and government policies which include the enactment of low taxes and tariffs on ICT resources, telecommunication liberalization, and the promotion of education, in general, and for computer professionals in particular (Dedrick et al., 1995; Dedrick and Kraemer, 1998; Kraemer et al., 1996; Dewan and Kraemer, 2000). Based on this, the following hypotheses are posited:

\( H2a \): Knowledge capital investment will interact with IT capital investment to positively affect economic productivity.

\( H2b \): The relationship between IT capital investment and economic productivity will be stronger for countries with high knowledge capital investment than for countries with low knowledge capital stock.

\( H3a \): Informatization of business models will interact with IT capital stock to positively affect economic productivity.

\( H3b \): The relationship between IT capital stock and economic productivity will be stronger for countries with high informatization of business models than for countries with low informatization of business models.

\( H4a \): Enactment of low taxes and tariffs on IT imports will positively affect economic productivity.

\( H4b \): The relationship between IT capital stock and economic productivity will be stronger for countries with low taxes and tariffs on IT imports than for countries with high taxes and tariffs on IT imports.

\( H5a \): Telecommunication liberalization will interact with IT capital stock to positively affect economic productivity.

\( H5b \): The relationship between IT capital stock and economic productivity will be stronger for countries with high telecommunication liberalization than for countries with low telecommunication liberalization.

\( H6a \): Promotion of education, in general, and for computer professionals in particular will interact with IT capital stock to positively impact economic productivity.

\( H6b \): The relationship between IT capital stock and economic productivity will be stronger for countries that promote education and computer professional education in particular than for countries with low education standards and poor support for computing education in particular.

Another frequently and consistently advanced explanation for the productivity paradox is the lag between IT investments and benefits (Brynjolfsson, 1993; Dewan and Kaeramer, 2000). It has been suggested that countries, organizations and individuals must acquire and accumulate a certain level of experience with technologies before they become proficient and thus fully exploit the potential of the technology. In explaining the high returns from IT investment in developed countries, Dewan and Kaeramer (1998) asserted “the developed countries have learned how to use the technology effectively over the past 30 years; part of the cost of their IT investments can usefully be thought of as the tuition paid for that learning”. Alternatively, the effects of IT investment on economic productivity were not realized in developed economies until the investment in ICT approached 1/3 of total capital investment. This suggests the following hypotheses:
**H7a:** IT capital investment makes positive contribution to economic productivity when it reaches a threshold of 1/3 of total capital investment.

**H7b:** The lag between IT capital investment and a positive impact on economic productivity is long-term approaching at the country-level.

**SUMMARY AND DIRECTIONS FOR FUTURE RESEARCH**

Based on our review of the literature on IT-productivity at the country level, there exists increasing evidence to suggest that the productivity paradox for developed economies has disappeared. Unfortunately, the productivity paradox still exists for developing countries where investments in IT fail to show a significant impact on productivity. The specifics as to how developed economies make better use of IT investments remain unknown.

Based on a review of the literature, the following factors were identified as potentially contributing to IT productivity: knowledge capital, informatization of business models, enactment of lower taxes and tariffs on computing imports, telecommunication liberalization, the promotion of education in general and computing professionals in particular, and the lag between IT costs and benefits due to learning and threshold ICT capital stock. Using these factors and the resource-based view (RBV) theory, a set of hypotheses were advanced. It is our contention that the proposed model, through its robust theoretical foundation, will provide a rich source for research on the relationships between IT investment and economic productivity for developing economies. Once investigated, findings can be used to support policy makers in developing countries and their investors.

This research is only beginning. We plan to further develop the concepts and empirically investigate many of the hypotheses. We know of no study that has operationalized the impact on IT investment from constructs of knowledge capital, informatization of business models and government policies factors (enactment of low taxes and tariffs on computer imports, telecommunication liberalization, and promotion of education generally and for computer professionals in particular) at the country level. As such much work remains to provide developing economies with the yet opaque and not yet delineated lessons of the developed economies.

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ABSTRACT

This work in progress examines the linkage between information systems development (ISD) risk and firm-level performance (conceptualized as competitive advantage). Investigating this link sheds some light on the firm performance implications of software development efforts; thereby reducing the isolation within which much ISD research is situated. More specifically, this study examines whether and how risk in ISD projects impacts competitive advantage, and under what conditions ISD success results in firm performance. We tried to understand the complex relationships between risk, ISD success, and firm performance to provide businesses with an understanding of how and under what conditions competitive advantage can be generated on the basis of software projects. Drawing from the literatures on ISD and information technology (IT) value, we propose that ISD risk impacts firm performance by reducing ISD success, and that the value arising from software projects is higher when business and IT plans are synchronized.

Keywords
IS success, Information systems development, Software project, Firm performance, IT value, Competitive Advantage

INTRODUCTION

Despite more than three decades of research on information systems development (ISD) projects, their successful management continues to challenge IS professionals (McFarlan, 1981; Kirsch, Sambamurthy, Dong-Gil and Purvis, 2002; Sambamurthy and Kirsch, 2000). ISD projects are often prone to failure; suggesting that information systems development is an inherently risky undertaking. Despite the presence of risk and its implications for software project success and failure, the literature shows little comprehensiveness regarding the risk construct and its nomological network.

As regards the risk construct, the vast majority of research on ISD risk looks at the risk inherent in the earlier stages of a project. Residual risk, on the other hand, is one of the underexplored risk concepts. It refers to the risk present in the later stages of the development project after appropriate actions have been taken to mitigate initial risks (Nidumolu, 1995). Concerning the nomological net within which ISD risk is situated, much ISD research has studied software projects in isolation, without relating them to other research streams. In particular, the link between risk, ISD success, and information systems value remains underexplored. This work in progress utilizes the concept of residual risk to examine whether and how risk in ISD projects impacts firm performance, and under what conditions ISD success results in firm performance.

This paper unfolds as follows. First, we will provide a background on the ISD literature as it pertains to residual risk. Afterward, our hypotheses will be developed on the basis of residual risk as well as concepts from IT value research. Subsequently, due to space limitations, the methodology will briefly be outlined at a very high level. The paper will end with concluding remarks.

BACKGROUND ON RESIDUAL RISK

In the ISD literature, risk has mostly been associated with project performance and consequently also been called performance risk, which is generally defined as the difficulty in estimating performance (Nidumolu, 1995). Research on ISD risk is largely concerned with the entirety of factors under a firm’s control that can be used to reduce risk. Such factors include, among others, user involvement, technology infrastructure, and top management support (Sambamurthy and Kirsch, 2000). While these factors have not commonly been grounded in theory, the Nidumolu model (Nidumolu, 1995) has more recently been applied to the study of ISD risk to broaden the theory base and theoretical perspective that is applied to the
The model takes into account that ISD risk has a temporal dimension, meaning that risk can affect software projects in the earlier stages of a project, such as initiation or system analysis, and in the later stages, such as coding, testing, and implementation. The latter has been referred to as residual risk (McFarlan, 1981; Nidumolu, 1995) and has most prominently been studied through the Nidumolu model.

Residual Risk is a special form of performance risk that has been applied to the study of information systems development project performance (Jiang, Klein and Chen, 2006; McFarlan, 1981; Na, Li, Simpson and Kim, 2004; Na, Simpson, Li, Singh and Kim, 2007; Nidumolu 1995, 1996). While risk in ISD projects has been studied extensively, the software engineering philosophy of tracing risks to multiple points in time – including late in the development life cycle – has not been widely acknowledged in research on information systems development. According to this philosophy, the extent of risk that remains in a project steadily decreases over time as project performance becomes more evident. Residual risk captures this aspect by referring to the “extent of performance risk present in the later stages of the project after project planning and requirements analysis have been completed (i.e., during design, coding, testing and implementation)” (Jiang et al., 2006; Nidumolu, 1995, p. 195). Accordingly, residual risk has been defined as the difficulty in estimating project performance during the later phases of the project (Nidumolu, 1995).

As regards the evolution of the concept of residual risk in the IS literature (see Figure 1), the idea has first been introduced by McFarlan (1981). While he did not use the term “residual risk” itself, he established the concept by studying the risk that remains after the project manager has applied risk mitigation methods. McFarlan suggested three important antecedents to this type of risk, which was later termed “residual risk” by Nidumolu (1995). These three antecedents are project size, experience with the technology, and project structure (where low structure implies that outputs are subject to change and managerial judgment). Nidumolu (1995) then not only termed this type of risk “residual risk”, but also gave it the concise definition mentioned above and used it as a mediator to explain how management activity and uncertainty relate to performance. His model was further specified by Nidumolu (1996) to study the effect of standardization on requirements uncertainty. Na et al. (2004, 2007) replicated his study using data from Korean firms to understand the concept of residual risk across firms with dissimilar IT capabilities. They found that firms with higher IT knowledge and resources have less residual risk, possibly because they more successfully mitigated risk in earlier stages of the project. Jiang et al. (2006) used the Nidumolu model to investigate the relationship and performance implications of user-partnering and user-nonsupport.

![Figure 1: Evolution of the concept of Residual Risk in the IS literature](image-url)
performance. Poor estimates of project performance may also result in high schedule pressure and unrealistic expectations. After all, the failure to carefully consider and evaluate residual risk and to take corrective actions is considered the reason for many project failures (Jiang et al., 2006; McFarlan, 1981; Nidumolu 1995, 1996). Moreover, managers are typically concerned about risk that cannot be effectively mitigated during the early stages of the development process (Na et al., 2007).

The vast majority of research has used the concept to understand how managerial action and uncertainty relate to success. In that vein, Nidumolu (1995), using the most generic form of the Nidumolu model (which is built around the concept of residual risk), studied how project uncertainty and mechanisms for coordinating project activities affect ISD performance. Nidumolu (1996) further specified the model to examine the effect of requirements uncertainty and standardization on the performance of software development projects. While Na et al. (2004, 2007) replicated Nidumolu’s (1996) study using data from Korean firms to understand residual risk across cultures, Jiang et al. (2006, p. 70) view the Nidumolu model as a “framework to investigate specific risks and techniques that, based on theory, might have a relationship”. They investigated how user non-support (uncertainty) and user partnering (managerial action) relate to ISD performance. In summary, the Nidumolu model offers a rich framework to understand the formation of residual risk and its impact on ISD success.

HYPOTHESES DEVELOPMENT

To answer recent calls for a stronger theory base in ISD research (Aladwani, 2002; Kirsch et al., 2002; Sambamurthy and Kirsch, 2000), a complementary set of three theories will guide model development. These are the Nidumolu model (Nidumolu, 1995), the well-known resource-based view of the firm (Barney, 1991; Mata, Fuerst and Barney, 1995; Wernerfelt, 1984), and the literature on business-IT strategic alignment (e.g., Chan, Huff, Barclay and Copeland, 1997; Chan, Sabherwal and Thatcher, 2006; Henderson and Venkatraman, 1992, 1993). Nidumolu’s (1995) model provides the baseline for our research. As discussed before, it allows us to model risk antecedents as well as the impact of risk on ISD performance. This model will be supplemented with the resource-based model (RBV), which provides a solid basis for evaluating the potential of ISD performance to result in competitive advantage. Specifically, RBV holds that resources that are valuable, heterogeneously distributed across firms, and difficult to imitate could yield sustainable competitive advantage (Mata et al., 1995). Wade and Hulland (2004) extended the theory so that it not only explains competitive advantage on the basis of single resources, but on the basis of resource interactions as well.

Finally, the literature on business-IT strategic alignment indicates that a greater degree of alignment between the business plan and the IT plan allows firms to better leverage their information technology investments (Chan et al., 1997). The model shown in figure 2 indicates that a reduction in software project risk affects information systems development success; thereby impacting performance when the extent of business-IT strategic alignment is high. Construct definitions are given in table 1.
Coordination refers here to the extent of such actions employed by project managers that can increase the availability of information. Management action can thereby reduce the extent of risk in the project. For example, ongoing cost-benefit analyses, close performance monitoring, and comparison of actual and planned performance baselines can reduce the performance risk (Boehm, 1989). More specifically, all these activities improve project management’s understanding of the project’s progress and thereby reduce the difficulty inherent in estimating performance. Hence, we suggest:

H1a: Coordination is negatively associated with residual risk.

Uncertainty is defined here as the extent of lack of complete information about project performance; making it difficult to accurately predict performance (Nidumolu, 1995). For instance, ambiguous, unstable, or incomplete requirements specifications create difficulty in predicting performance outcomes since such imperfect specifications often necessitate ongoing repetitions of the requirements analysis (Jenkins and Wetherbe 1984). Therefore, we propose:

H1b: Uncertainty is positively associated with residual risk.

Coordination may also directly affect project performance, in addition to its indirect effect that is mediated by residual risk. For example, if project management arranges for a high degree of user participation in the project, the final system may be more likely to address the needs of its users. Moreover, management action may improve upon team member morale, thereby increasing group performance (Nidumolu, 1995). Accordingly, we propose:

H2a: Coordination is positively associated with ISD success.

Uncertainty may also directly influence ISD success, for example in the case of conflicts between users and project team members. Such conflicts can require significant time and effort to resolve; thereby directly reducing ISD success (Nidumolu, 1995). Likewise, employing new technologies throughout the software project may result in software problems, which could subsequently reduce the extent of software and process performance. Thus, we hypothesize:

H2b: Uncertainty is negatively associated with ISD success.

Residual risk makes it difficult for project management to accurately allocate resources throughout the project and to plan for proper implementation. More generally, a variety of studies have suggested a negative relationship between risk and performance (e.g., Lyytinen, Mathiassen and Ropponen, 1998; Nidumolu, 1995; Wallace, Keil and Rai, 2004). Hence:

H3: Residual Risk is negatively associated with ISD success.

Firm performance is defined here as the extent of competitive advantage resulting from resources that are valuable, heterogeneously distributed across competing firms, and potentially difficult to imitate by competitors (Mata et al., 1995). Proprietary software systems resulting from ISD projects are likely to be valuable since they are generally developed to improve organizational processes. They are furthermore likely to be heterogeneously distributed across competing firms since they tend to be developed by single players. However, when considered as isolated resources, proprietary software systems may not be difficult to imitate since information about such systems can simply be handed over to competitors, for example when systems developers are hired away by competing firms.

Thus, any competitive advantage derived from a proprietary system might not be sustainable. However, IT assets generally result in sustainability if they are complemented with other resources (Bharadwaj, 2000; Melville, Kraemer and Gurbaxani, 2004; Wade and Hulland, 2004). Such complementary sets tend to be ambiguous so that competitors face difficulty understanding the cause of the performance benefits of an IT asset. Aral and Weill (2007) and Tanriverdi (2006) posit that IT can also yield sustainable competitive advantage on its own when IT assets are complemented with IT capabilities.

Business-IT strategic alignment may be one such capability with the potential to complement proprietary software so that sustainable competitive advantage can be achieved. The alignment literature holds that IT investments can generally be leveraged more effectively when the IT plan reflects and supports the business plan; thus ensuring a more focused use of the IT resource (Chan et al., 1997). Accordingly, if the newly developed system is complemented with high levels of business-IT strategic alignment, it is likely to yield a sustainable competitive advantage. This discussion leads to the following two hypotheses:

H4: ISD success is positively associated with firm performance.

H5: This relationship is positively moderated by Business-IT strategic alignment so that it is stronger for higher levels of alignment.
BRIEF OUTLINE OF PROPOSED METHODOLOGY

While most research on ISD projects has employed cross-sectional survey research (e.g., Jiang et al., 2006; Nidumolu, 1995; Wallace et al., 2004), the above model can more effectively be tested using longitudinal survey research. Longitudinal research can more effectively counter-act the problem of common method variance (Malhotra, Kim and Patil, 2006; Podsakoff, MacKenzie, Lee and Podsakoff, 2003), while simultaneously establishing temporal precedence, thus increasing internal validity (Straub, 1989). While experimental research could yield even stronger internal validity, lab data is usually less representative of the business environment than is field data. Additionally, internal validity in survey research can be further advanced by adding control variables. Hence, we will employ longitudinal survey research.

While most measures will be perceptual, we will triangulate with objective measures were possible. Measures for the above constructs are already available (e.g., Kearns and Lederer, 2003; Nidumolu, 1995; Tanriverdi, 2006). They will be adapted where necessary on the basis of the guidelines outlined by Churchill (1979), Clark and Watson (1995), and Straub (1989). Organizations will be selected at random from the auto parts manufacturing industry. Because of the large number of software projects these firms have to manage to comply with the requirements of original equipment manufacturers and due to the small margins that characterize the industry, there is some evidence that these firms have ample interest in understanding how to more effectively leverage their IT projects. Consistent with much prior research (e.g., Aladwani, 2002), project managers will be targeted as respondents.

As regards control variables for firm performance, we will control for firm size, industry, and strategic orientation (Chan et al., 2006). Concerning ISD success, we will control for user involvement and top management support.

CONCLUSION

This research was motivated by the questions of whether and how risk in ISD projects influences firm-level performance, and under what conditions ISD performance results in firm performance. The study suggests that ISD risk indeed affects firm performance by reducing ISD success (and subsequently competitive advantage), and that the IT value stemming from software projects will be higher when business and IT plans are synchronized. Such synchronization may imply that any competitive advantage arising from software projects is more likely to be sustainable.

This research contributes to the literature on information systems development risk primarily by linking it to firm-level performance; thereby moving research on software projects out of the isolation within which it is generally conducted. This allows us not only to connect ISD research to other research streams, but also to explore the firm-level performance impacts of software projects. We indicate that project performance results in firm-level performance when business-IT strategic alignment is high, so that the proprietary system can be leveraged more effectively by the employing firm.

Future research can use the link proposed here to create further connections, for example to innovation research. Due to the multiplicity of theoretical lenses that may become available, connecting ISD research to other research streams may aid understanding of how the problems involved in many software projects can be resolved. Another useful avenue is to further explore the link between ISD success and firm performance. Are there other important moderators not considered here?

This research yields important implications for practitioners as well. Specifically, senior executives may need to take a closer look at organizational software projects as these projects might constitute a mechanism to influence firm performance. By working closely together with the chief information officer, business executives can align IT and business plans (Chan et al., 1997), thereby strengthening the positive impacts software projects may have on firm performance.

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CAN IT RESOURCES LEAD TO SUSTAINABLE COMPETITIVE ADVANTAGE?

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ABSTRACT
Gaining sustainable competitive advantage (SCA) is a desire for almost every organization; however, acquiring such advantage is not an easy task. Many organizations implement information technology (IT) systems to be competitive in the market, and many researchers have examined the link between IT and SCA. Organizations need to focus not only on IT resources but also on how to manage these resources to be competitive in the marketplace. In this paper, a new model is proposed based on resource-based view and strategic alignment model. By linking strategic IT resources to alignment mechanisms, this model shows the ability of IT as a facilitator in gaining competitive advantage.

Keywords
Resource-based view, alignment, sustainable competitive advantage

INTRODUCTION
Organizations want not only to gain competitive advantages, but also want these advantages to last for the longest possible time. Many IT applications offer the possibility for competitive advantage, however, over time competitors will be able to imitate these applications; they become a prerequisite for doing business, and the competitive advantage only lasts a short time. Some IT applications may provide only limited advantages to the first movers before competitors copy these applications (Vitale, 1986). Many competitors are not only imitating the applications, but also hire the same contractors and outsource to the same vendors (Ross et al., 1996). Nevertheless, many firms like Wal-Mart and Federal Express have established that the ability “to apply IT to business opportunities” enhances their competitiveness (Ross et al., 1996). These firms have the ability to apply IT applications for continually changing business opportunities.

The objective of this paper is to investigate the concept of IT as a facilitator of competitive advantage. This investigation is accomplished by designing a new model based on the literature of the resource-based view (RBV) and the strategic alignment model (SAM) (Henderson & Venkatraman, 1999). This proposed model should be useful for both researchers and practitioners in that it will expand the researchers’ mindset to include not only IT resources but also alignment mechanism when thinking of maintaining SCA, and offer practitioners a greater chance of gaining SCA.

Competitive advantage is defined as gaining a return-on-investment (ROI) above the industry average (Porter, 1985). According to (Barney, 1991), a competitive advantage is implementing an effective strategy not “simultaneously” implemented by current or future competitors. Sustained competitive advantage is implementing an effective strategy not “simultaneously” implemented by current of future competitors and those competitors being unable to “duplicate” the advantages of this strategy. “A competitive advantage is sustained only if it continuous to exist after efforts to duplicate the advantage have ceased” (Barney, 1991). We can say a firm has a SCA when it is implementing a strategy not implemented by its competitors at the same time, and where these competitors face “significant disadvantages” in getting the necessary resources to implement the strategy (Mata et al., 1995). We should keep in mind that most innovative application of IT will turn to strategic necessities that most companies need to have, and in rare conditions the innovative application will be SCA. Strategic necessity is the IT investment that is implemented not for competitive advantage but because it becomes an important part of doing business.

The rest of this paper is arranged as follows: Section 2 is a literature review; section 3 is an overview of RBV; section 4 is the proposed model; and finally we conclude in section 5 with a summary of results and future directions.

LITERATURE REVIEW
There are many studies that attempted to link IT resources and the firm’s performance (Wade and Hulland, 2004). Ross et al., (1996) suggested that the combination of three IT assets, namely IT human resources, technology base, and relationship,
determine the quality of IT delivery, development, and support processes. They argued that the difference is not in the technologies itself but in these three IT assets and how they are implemented in the firm. Clemons and Row (1991) developed a resource-based theory arguing that differences in strategic resources among firms to develop IT innovation are important to maintain SCA. They proposed the “strategic necessity” hypothesis which means IT alone cannot lead to SCA; however it may assist other resources to acquire SCA. Neo (1988) asserted that “existing systems” are important for implementing IT for competitive intentions.

On the other hand, there are only few studies that found that IT has either negative effect on competitive advantage (Warner, 1987), or found that IT has no effect on performance (Venkatraman and Zaheer, 1990; Sager 1988). The majority of the findings show IT has positive impact on acquiring competitive advantage (Kettinger et al., 1994; Feeny and Ives 1990; Clemons and Weber, 1990; Li and Ye, 1999; Clemons and Row, 1991; Schwarzer, 1995; Bharadwaj, 2000)

Some researchers found that IT management is the important key to get SCA. For example, Ray et al. (2001) found that managerial IT skills improved performance of customer service; Mata et al. (1995) adopted resource-based theory to explore whether IT can lead to SCA, and if so, how this can be done. After discussing the theory assertions, the relationship between SCA and the five IT attributes: customer switching costs, access to capital, proprietary technology, technical IT skills, and managerial skills; the authors concluded that only managerial IT skills are likely to lead to SCA. In addition, Pereira (1999) tried to explore whether enterprise resource planning (ERP) technology provides SCA. He found that ERP could lead to SCA if high management skill is applied. Implementing ERP is not enough; changing the organizational culture toward team work, and changing business processes to fit ERP capabilities are required. Also, Waserman, Pagell, and Bechtel (1999) examined the source of competitive advantage from an across-functional perspective; they argued that high performance results from well managed organizational capabilities include tangible assets and intangible assets.

OVERVIEW OF RESOURCE-BASED VIEW

The focus of RBV is resources. Resources include everything in the organization that benefit both the customers and the organization. One classification of resources is tangible and intangible resources. These resources include communication within an organization, and manager’s skills (Waserman, Pagell, Bechtel, 1999). Another classification is to human resources (e.g. chief executive commitment), business resources (e.g. suppliers relationships), and IT resources (computer hardware) (Thomas and Anne, 1997); IT resources are an important aspect for getting and maintaining SCA. Clemons and Row (1991) defined them as “any long-lived productive capability” which includes tangible assets such as databases and hardware, and intangible assets such as IT skills, patents, and managerial expertise.

The firm consists of different types of resources such as business and technical resources. In order for these resources to lead to a competitive advantage, they should possess unique characteristics, and in which case they become strategic resources. Also, these strategic resources are called “distinctive competence” (Hayes and Wheelright, 1984), “competitive advantage” (Porter, 1985), “asset stock accumulation” (Dierickx and Cool, 1989), “capabilities” (Stalk, Evan, and Schulman 1992), and “core capabilities” (Clark, Holloway, and Wheelwright, 1994). In order to understand these resources, we need to understand their unique characteristics. For example Barney (1991) listed four of them: value, rareness, inimitability and non-substitutability:

Rareness and heterogeneity mean that strategic resources are not the same among firms but are unique. A unique IT resource is a prospect source of competitive advantage and firms need to build their strategies around these unique capabilities. As Clemon and Row (1991) argue, “Information technology can lead to sustainable competitive advantage when it is used to leverage differences in strategic resources”. Valuable resources are valuable when they help in implementing strategies that improve the firm’s efficiency. Non-substitutability means that the resource should have no substitute in order to lead to SCA. If there is any other substitute that lead to the same strategy, the first resource loses its ability to lead to SCA. Immobility (inimitability) means these differences among resources should last for long time (Wernerfelt, 1984); if the resources are mobile, then they can easily be acquired by competitors, so SCA can not be obtained when strategic resources are evenly distributed (homogeneity) across competing firms and are highly mobile (Barney, 1991).

For example, the technological applications, such as knowledge bases, and inventory applications, all provide future opportunities; these applications might not be unique and they are easy to copy, but at the same time these applications might rely on unique infrastructure that competitors face a cost disadvantage in imitating such infrastructure (immobility). Thus a follower can copy the application of the first-mover, but will not be able to copy the original distinction that the system relies on for success (Feeny and Ives, 1990). According to Mata et al. (1995), “if a firm without a resource or capability does face a cost disadvantage in obtaining, developing, and using it compared to a firm that already possesses that resource (i.e., resource immobility), then the firm that already possesses that resource can have a sustained competitive advantage”. In fact, if this differentiation of the infrastructure is really a unique advantage, it would be very hard for a competitor to challenge.

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Resources uniqueness is not only critical, but also a firm’s structure uniqueness is important as Clemons and Row (1987) argued that the advantage of the application comes from “unique structural characteristics of the innovating firm”.

**PROPOSED MODEL**

The proposed model (figure 1) focuses on two important pillars; the first one is the dual ability of IT resources to support and to be supported by the corporate strategy, and to enable the IS application strategy. The Second pillar is implementing SAM (Henderson & Venkatraman, 1999) between the internal and external entities of the organization.

![Figure 1: A Model Links IT Resources to Alignment Requirements and SCA](image)

**IT Resources and IS Application Strategy**

IT is an important component of firms’ strategy. The ‘enable’ link between IT resources and information systems (IS) application strategy in figure 1 means that strategic IT resources should enable important business strategies to acquire SCA. According to Porter (1985), in order to have a competitive advantage, there are three generic competitive strategies: cost leadership, differentiation, and focus. Other researchers expanded these three to include more strategies; for example, Barney (1997) noted that IT resources might be used to implement different types of strategies such as cost leadership, product differentiation, vertical integration, and strategic alliance strategies. If these resources are heterogeneous and immobile among competing firms, these resources have the potential for SCA. IT resources might have the ability to enable a unique strategy that lead to SCA. IT can be used to develop product quality, improve customer service, or decrease costs (Clemons and Row, 1991).

A clear cost leader is Wal-Mart; careful management of inventory systems at Wal-Mart led to minimize storage costs. When a company is applying differentiation strategy, it will offer unique products or services that are valued by its customers. Again, IT resources have the ability to enable this strategy to acquire SCA. For example, FedEx differentiates itself from other competitors. As Keller, Sternthal, and Tybout (2002) noted, “this type of differentiation would be supported by FedEx’s heavily promoted tracking capabilities, which distinguish it not only from fax and e-mail, but from other overnight delivery carriers as well”.

As a general example, e-commerce firms have new strategies to sustain competitive advantage by implementing one or more of Porter’s strategies (Lumpkin et al., 2002); the authors noted that, “the Internet offers overall cost leaders new ability to reduce costs in primary activities such as marketing and support activities such as purchasing”; the authors gave differentiation example from Dell Computer Corporation; Dell allows customers to configure their own computers according
to their specifications. Finally, a focus strategy is implemented when the firm is focusing on a particular geographic market, product line, or group of customers. By implementing focus strategy, the Internet has opened new markets for small firms to compete.

**IT Resources and Corporate Strategy**

The ‘support’ link between IT resources and corporate strategy in figure 1 means strategic IT resources should support and supported by the corporate strategy to gain SCA. The model focuses on two important aspects of the corporate strategy. The first one is strategic objectives, and the second one is top-management commitment as important part of the firms’ vision.

IT should be used to support firms’ objectives, for example IT can be used to meet internal and external customers’ business objectives. As Thomas and Anne (1997) suggested that IT affects firms’ strategies that have IT implications; so many IT researchers support strong relationship between IT and firms’ strategies and the firms should integrate strategic power with IT capabilities (Beath and Ives 1986). Firms implement new systems to raise efficiency (e.g. reduce cost); IT programs should support a firm’s strategic objectives. It is required by many IT researchers and consultants that firms should integrate IT with overall strategic planning efforts (e.g. Bakos and Treacy, 1986; Beath and Ives, 1986; Clemons and Row, 1991; Holland et al., 1992).

Top-management needs to be involved in “establishing IT priorities”. This is why many firms are forming teams of senior manager to act as “IT steering committees” which express organizational strategies at corporate/business level and specify how IT supports them. Henderson & Venkatraman (1999) noted the strong relationship between the chief executive officer (CEO) commitment and successful IT implementation. CEOs need to support the need of IT, and communicate their IT vision to the organization’s strategy. Neo (1988) reported the “management vision and support” as a factor that differentiates between successful IT implementation and unsuccessful IT implementation. Benjamin et al. (1984) talked about the concept of “senior management entrepreneur” who deals with IT as the heart of business thinking; these managers want to know how the firms’ strategic decisions are affected by IT.

For example, top management support makes the required IT resources available for implementation. Integrating IT strategy with business strategy and process will be easier. In addition, there will be a guarantee of continuous IT investment over time (Kettinger et al., 1994). Without top management support, important projects may fail. For example, in 1992, Eastman Kodak had decided to implement SAP for its global operations and financial management; the project had been discontinued after two years; “key manager, including the chief financial officer, never fully supported the project”. (Pereira, 1999)

**Required Alignment**

The importance of IS alignment has been confirmed by many research such as Porter (1985), and Kang et al. (2008). IS alignment is the bridge that links the IS view to different views in the organization and its environment (Avial, Goepp, and Kiefer, 2009). Alignment is one of the important factors that assist the recognition of strategic IT application (Neo, 1988). The corporate strategic vision should be aligned with the IS strategic vision and the IT products and services need to be aligned with the firm’s strategic objectives.

Based on SAM (Henderson & Venkatraman, 1999), strategic alignment consists of two main parts: strategic fit and functional integration. Strategic fit determines the need for any strategy between external and internal domains while functional integration recognizes the need for strategy inside either an internal or external domain. There are two ‘functional integration’ links in figure 1; one is internal among IT resources, IS application strategy, and corporate strategy; the other one is external between IT infrastructure and business strategy. In addition, there are two ‘strategic fit’ links in figure 1; the first one is between internal IS application strategy and external IT infrastructure. The other one is between internal corporate strategy and external business strategy. Business and IT integration is very important for firms to accomplish their competitiveness (Wegmann, 2003). Firms need to have functional integration at the internal level and external levels. Strategic fit should be maintained between internal IS application strategy and external IT infrastructure, and between internal corporate strategy and external business strategy.

As Clemons (1986) suggests, consistency between IS management and strategic planning is important not only for selecting the IT opportunities, but also for protecting these opportunities. IS scope and governance should be consistent with business scope and governance. This consistency should be at all organization levels: top management, middle management, and lower IS management. Top management, for example, provides the required long-term and strategic planning; middle management understands customer requirements and company opportunities; IS management understands the current IT resources, and its competences that are already in place. By doing so, IT applications will allow top-managers to discover and implement opportunities to react to strategic needs better, faster, and cheaper than their competitors.
CONCLUSION

IT resources alone are not likely to generate sustainable competitive advantage. To gain SCA, IT resources need to have the ability to support and be supported by corporate strategy. In addition, IT resources should have the ability to enable IS strategy. Moreover, strategic fit is also needed between internal IS application strategy and corporate strategy. The proposed model is enhancing the RBV by including an alignment mechanism which is essential for every firm. This enhancement will broaden the researchers’ scope in future research. Also, an empirical evaluation of this model is the required next step; future research is needed to answer the questions “how can IT resources enable IS strategy to acquire SCA?” At the same time, “how can IT resources support corporate strategy to be competitive?” And “how can alignment mechanism be implemented to help in achieving SCA?”

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UNDERSTANDING SOCIAL NORMS, ENJOYMENT, AND THE MODERATING EFFECT OF GENDER ON E-COMMERCE ADOPTION

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ABSTRACT
Understanding e-commerce system adoption is an important topic for e-commerce designers and electronic customer relationship managers. Even though there are a lot of research endeavors to explain e-commerce adoption, one of the main questions to be answered is regarding the normative and affective factors based on the theory of reasoned action and the self-determination theory. In this paper, the relationships among the social norms, perceived enjoyment, and their relationships to intention to adopt e-commerce system are tested (n = 322). Furthermore, the moderating effects of gender are tested based on the socio-linguistic literature. As expected, the influence of social norms is stronger in the female group while the influence of enjoyment is stronger in the male group. Interestingly, a female is more influenced by her friends while a male is more influenced by his family and media. Theoretical and practical implications of these findings are discussed in the paper.

Keywords
E-commerce, social norms, enjoyment, gender, technology adoption

INTRODUCTION
Electronic commerce (e-commerce) systems adoption is an important topic for e-commerce designers and human-computer interaction researchers. (Saeed et al., 2003; Gefen et al., 2003; Birkhofer, Schagel, and Tomczak, 2000). Even though there are a lot of research endeavors to explain e-commerce system adoption and online consumer behavior (e.g., Gefen et al., 2003; Grazoli and Jarvenpaa, 2000; Pennington et al., 2004), one of the main questions is how to understand the influences of social normative and affective factors on electronic customer relationship management (Saeed et al., 2003). Specifically, the complex effects of social norms – as a normative factor – and the perceived enjoyment – as an affective factor – on intention to use e-commerce system have not been tested in the previous research. This study investigates these important relationships with the moderating effects of gender based on the theory of reasoned action, self-determination theory, and socio-linguistic literature. The detailed discussion of these theories and hypotheses are in the next sections.

RESEARCH MODEL AND HYPOTHESES
Malhotra and Galletta (2005) recently argued that a system user’s affective commitment development was omitted in the previous research model which investigated IS adoption. A better understanding of the nature of systems users’ affective and social normative factors will promise to contribute to the design of more effective e-commerce system and the company’s successful electronic customer relationship management. Sociolinguists also have claimed for years that men and women communicate with different underlying social objectives and that their communication patterns are very different (Tannen, 1991, 1994, 1995). Yet the effects of gender on e-commerce system adoption have been ignored in IS research, even though gender is a fundamental aspect of individual behavior, based on socio-linguistic research (Gefen and Staub, 1997). Although it is clear that gender should be considered in understanding social, affective, and intrinsic aspects, nobody has studied this important aspect to understand the affective and normative social factors. In this study, social norms and the perceived enjoyment are hypothesized as direct antecedents to users’ intention to use the e-commerce system. Further, the moderating
effects of gender are tested in the model based on socio-linguistic research (Tannen, 1994, 1995) and current IS literature (Gefen and Ridings, 2005; Venkatesh et al., 2003). The proposed research model is in Figure 1, and the detailed hypotheses are as follows.

Figure 1. Proposed Research Model

Online consumer behavior is a voluntary individual behavior that can be explained by theory of reasoned action proposed by Fishbein and Ajzen (1975). This theory argues that behavior is preceded by intentions and that intentions are determined by the individual’s attitude – similar to the perceived enjoyment – toward the behavior and the individual’s social norms. There are several IS studies focusing on social norms or environmental influence on online consumer behavior. Limayem et al. (2000) suggested that social norms influence purchase intention, using formative construct of social norms (family, media, and friends influences) in online consumer behavior. Thus, we hypothesize that;

**H1**: Social Norms will have a positive effect on Intention to Use.

Self-determination theory (Deci & Ryan, 1985) showed that all individuals have natural, innate, and constructive tendencies to develop an ever more elaborate and unified sense of self. It focuses on how individuals develop a coherent sense of self through regulation of their behavioral actions that may be self-determined, controlled, or motivated. Malhotra (2002) argued that tacit perspective of systems adoption should be managed and controlled mainly by intrinsic motivation rather than by formal controls based on the self-determination theory. Prior research such as theory of reasoned action proposed intrinsic motivation, such as perceived enjoyment or attitude, as a determinant of perceived ease of use and intention to use (Venkatesh, 2000; Venkatesh et al., 2002; Yi & Hwang, 2003). Thus, we hypothesize that:

**H2**: Perceived Enjoyment will have a positive effect on Intention to Use.
Gefen and Straub (1997) showed that women sense more social presence in work-related emails. Venkatesh and Morris (2000) also showed that women are more affected by social norms in their adoption of IT. Women do so more with the objective of creating social inclusion, while men communicate more with the objective of creating and preserving their status and exchanging information (Gefen and Ridings, 2005; Tannen, 1994). In the unified theory of acceptance and usage of technology (UTAUT) model, Venkatesh et al. (2003) showed that women have a stronger relationship between social influence and behavioral intention. Thus, we hypothesize that;

**H3: Social Norms will have a stronger effect on Intention to Use in Females.**

On the other hand, Venkatesh et al. (2000) also found that the decisions of men were more strongly influenced by their attitude (or perceived enjoyment) toward using the new technology, while women were more strongly influenced by social norm and perceived behavioral control. Generally, men are supposed to be more sensitive to self-motive or self-satisfaction than women (Anderson and Leaper, 1998; Edelsky, 1993; Herring, 1993; Holmes, 1992; Kilbourn and Weeks, 1997; Weatherall, 1998; West and Zimmerman, 1983). Based on an extensive review of the literature, Minton and Schneider (1980) concluded that men tend to be more self-confident that would be related to the intrinsic motivation. Thus, we hypothesize that;

**H4: Perceived Enjoyment will have a stronger effect on Enjoyment in Males.**

We also expect that there would be moderating effects of gender in the different social influences on the norms. Since there is limited previous research on these specific relationships, we did not propose the specific directions on the moderating effects of gender. The empirical test results and findings would provide useful practical implications to the e-commerce system designers and electronic customer management relationship researchers. We hypothesize that;

**H5-1: Family Influence will have a different effect on Social Norms in Gender.**

**H5-2: Media Influence will have a different effect on Social Norms in Gender.**

**H5-3: Friends Influence will have a different effect on Social Norms in Gender.**

**METHOD AND PRELIMINARY ANALYSIS**

The online survey was implemented with undergraduate business students, who voluntarily participated. The target university for the survey is in the northern region of the U.S. The experiment was conducted in an Internet classroom as suggested by Gefen (2002). Students were approached in an Internet-connected classroom, where each student had his/her own PC. The students were asked to navigate to [www.amazon.com](http://www.amazon.com) and go through the procedure of purchasing a book without actually submitting the purchase transaction. Next, the students were asked to complete the experimental instrument of an online survey based on their experiences with the website. The main objective of this experiment was to refresh the participants’ memory without manipulating the participants or creating perception. We developed an online survey website and posted this URL to the class management system (Blackboard™) for the students to access.

In the main test, 322 students voluntarily participated in the study. We awarded bonus points to the final grade of survey participants. It took around 20 minutes for the participants to navigate the website and 25 minutes to complete the survey. The average age of the main test participants was 22 years, and 56% were female. 92% of participants reported having used e-commerce website to buy products before. 66% reported having used Internet 4 to 20 hours in a week, while 20% replied more than 20 hours. 15% replied that they used Internet less than 3 hours in a week. All measurement items are adapted and revised from previous research on the theory of reasoned action and the self-determination theory as we explained in the hypotheses section (see Appendix for detailed items). All questionnaire items used a 5-point Likert-type scale where 1 = completely disagree, 3 = neither agree nor disagree, and 5 = completely agree.

Measure validation and model testing were conducted using Partial Least Square (PLS) Graph Version 3.0 (Chin & Frye, 1998), a structural equation-modeling (SEM) tool that utilizes a component-based approach to estimation. PLS makes few assumptions about measurement scales, sample size, and distributional assumptions (Chin, 1998; Falk & Miller, 1992; Fornell & Bookstein, 1982; Wold, 1982). The model in this study has complex moderating relationships with the formative construct that can be tested by the PLS manipulation (Keil et al., 2000). Chin (1998, p. 311) advises that “if one were to use a regression heuristic of 10 cases per indicator,” the sample size requirement would be 10 times (1) the largest number of formative indicators or (2) the largest number of independent variables impacting a dependent variable, whichever is the greater. In our model, the largest number of formative indicators is only three. Thus, our sample size of 322 is more than adequate for the PLS estimation procedures.
Before testing the hypothesized structural model, we first evaluated the psychometric properties of the study variables through confirmatory factor analysis. The measurement model was assessed by using PLS to examine internal consistency reliability (ICR) and convergent and discriminant validity (Barclay et al., 1995; Chin, 1998; Yi & Davis, 2003). Internal consistencies of 0.7 or higher are considered adequate (Barclay et al., 1995; Chin, 1998; Yi & Davis, 2003). To assess convergent and discriminant validity, the square root of the average variance extracted (AVE) by a construct should be at least 0.707 (i.e., AVE > 0.50) and should exceed that construct’s correlation with other constructs. Table 1 shows that the psychometric properties of the study variables were considered relevant and sufficiently strong to support valid testing of the proposed structural model.

Table 1. Weights, Loadings, Internal Consistencies, and Correlations (n=322)

<table>
<thead>
<tr>
<th>Construct</th>
<th>Weight/Loading</th>
<th>ICR</th>
<th>Social Norms</th>
<th>Enjoyment</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Norms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SN1</td>
<td>0.62</td>
<td>0.70</td>
<td>0.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SN2</td>
<td>0.23</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SN3</td>
<td>0.55</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enjoyment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EN1</td>
<td>0.92</td>
<td>0.93</td>
<td>0.32</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>EN2</td>
<td>0.92</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EN3</td>
<td>0.89</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USE1</td>
<td>0.76</td>
<td>0.89</td>
<td>0.35</td>
<td>0.38</td>
<td>0.85</td>
</tr>
<tr>
<td>USE2</td>
<td>0.87</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USE3</td>
<td>0.91</td>
<td></td>
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</tbody>
</table>

The PLS structural model and hypotheses were assessed by examining path coefficients and their significance levels. Following Chin (1998), bootstrapping (with 500 resamples) was performed on the model to obtain estimates of standard errors for testing the statistical significance of path coefficients using a t-test. Figure 2 provides the results of hypothesis testing. All direct paths in the model were supported within the 0.001 significance level. To test the moderating effects of gender, we adapted the procedure by Keil et al. (2000). Hypotheses 3 – 5(3) were examined by comparing the path coefficients based on Wynne Chin as described by Keil et al. (2000). All the hypotheses were confirmed within the 0.001 significance level. Table 2 shows these results.

CONCLUSION

This research in progress investigates the normative and affective factors based on the theory of reasoned action and the self-determination theory. Furthermore, the moderating effects of gender are tested based on the socio-linguistic literature. In the preliminary analysis with 322 samples, the influence of social norms is stronger in the female group while the influence of enjoyment is stronger in the male group. Interestingly, a female is more influenced by her friends while a male is more influenced by his family and media. The findings of this study would be helpful for the e-commerce researcher and practitioners in understanding the online consumers’ behaviors, which is essential for the successful e-commerce systems implementation.
Table 2. Comparison of the Path Coefficients in both Samples

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Male (n=138)</th>
<th>Female (n=184)</th>
<th>T-value comparing the two genders</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Path coefficients</td>
<td>Standard Error</td>
<td>Path coefficients</td>
</tr>
<tr>
<td>H3: Social Norms will have a stronger effect on Intention to Use in Female.</td>
<td>0.21***</td>
<td>0.079</td>
<td>0.28***</td>
</tr>
<tr>
<td>H4: Perceived Enjoyment will have a stronger effect on Enjoyment in Male.</td>
<td>0.40***</td>
<td>0.077</td>
<td>0.25***</td>
</tr>
<tr>
<td>H5-1: Family Influence will have a different effect on Social Norms in Gender.</td>
<td>0.78***</td>
<td>0.154</td>
<td>0.51***</td>
</tr>
<tr>
<td>H5-2: Media Influence will have a different effect on Social Norms in Gender.</td>
<td>0.27*</td>
<td>0.240</td>
<td>0.18**</td>
</tr>
<tr>
<td>H5-3: Friends Influence will have a different effect on Social Norms in Gender.</td>
<td>0.37**</td>
<td>0.243</td>
<td>0.64***</td>
</tr>
</tbody>
</table>

Note. * p < .05; ** p < .01; *** p < .001
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ASSESSING MOTIVATION IN ECOMMERCE

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ABSTRACT
This research-in-progress paper examines factors that affect ecommerce. The design of ecommerce web sites has offered many challenges and opportunities for organizations throughout the world. There has been a rich stream in the information systems research on the antecedents of good web design. This has included ideas of how the size of the web site (e.g. the download delay) affects users’ perceptions or even how interactive components affect consumer behavior. The contributions of this paper are two-fold. First, a conceptual model of the factors influencing online consumer motivation is presented. This model draws on Self-Determination Theory (SDT) as well as the current practices used in web design. The model adapts concepts from SDT, and references components of use of motivation in design. Second, this paper presents an instrument that has been validated in laboratory and field tests.

Keywords
Ecommerce, Motivation Theory, EBusiness, EDT, Intrinsic Motivation

INTRODUCTION
The design of ecommerce web sites has offered many challenges and opportunities for organizations throughout the world. There has been a rich stream in the information systems research on the antecedents of good web design. This has included ideas of how the size of the web site (e.g., the download delay) affects users’ perceptions (Galletta, Henry, McCoy, & Polak, 2006) or even how interactive components affect consumer behavior (Campbell & Wright, 2008; Palmer, 2002). In this paper, we will go a step beyond examining which components of a web site affects consumer behavior and evaluate the possibility that there are psychological needs that can inform ecommerce web design. Specifically, Self-Determination Theory (SDT) will be presented as a framework to understand how psychological needs can inform web design elements in an ecommerce context.

At the center of SDT is motivation (Deci, 1975; Deci & Ryan, 1985; Ryan & Deci, 2000). Motivation, “concerns energy, direction, persistence and equifinality – all aspects of activation and intention.” (Ryan & Deci, 2000). Motivation in ecommerce can be highly valued as it offers insight into the consequences of behavior (e.g. consumer behavior). In other words, by understanding ones motivation in certain contexts we can determine the design factors that affect their consumer behavior.

The contributions of this paper are two-fold. First a conceptual model of the factors influencing online consumer motivation is presented. This model draws on SDT as well as the current practices used in web design. The model adapts concepts from SDT and references several components of use of motivation in design (Fang & Salvendy, 2000; Galletta et al., 2006; Palmer, 2002; Zhang, 2008). Second, this paper presents an instrument that has been validated in laboratory and field tests.

PAST RESEARCH
Most ecommerce systems have unique objectives, features and structures that are based on certain organizational goals. Although there are many different types of systems, web designer have argued that consumers expect certain features in certain locations and therefore standard design must be used in ecommerce web sites. Unfortunately, the extant literature on the use of standards by organizations in their ecommerce web site has suggested that the design of ecommerce web sites has not exactly been standardized. This includes the attributes offered, the layout and so on.

The literature shows that different organizations use their ecommerce web sites in very different ways that may or may not include standards in design. We argue that this lack of congruence in the literature and in practice is due to the under-utilization of human behavior factors that affect a user’s perception of certain web design components. At stated above, using the motivations in human behavior may offer insight into how a user’s perceptions are formed about web design components. Next we examine the extant motivation literature to explain in detail the linkage of motivation to a user’s perception of a web site.

Motivation Literature
Recently there has been a call to study motivation in the context of information and communication technology (ICT) (Zhang, 2008). There are two basic questions that the motivation literature, in general, attempts to answer. First is what causes certain behavior and second why does behavior vary in intensity (Reeves, 2005). By examining these issues within an ecommerce context we have the opportunity to study the factors that positively affect certain desirable online consumer behaviors (e.g. satisfaction, intent to return, and so on). The significance of studying motivation is clear as it offers a valuable association: motivation produces. Although many times motivation is treated as a single or first-order construct, it is evident that people are moved to act by very different factors. We define motivation, similar to Deci (1975), as a state that is influenced. Further, it must be pointed out that there is a clear distinction between motivation and personality and emotion (Deci & Ryan, 1985). SDT posits that motivation can be formed by external factors (e.g. strong external coercion) and by internalized factors (e.g. value an activity), these are called extrinsic and intrinsic factor respectively.

Extrinsic and intrinsic are two fundamental types of motivation that have been used extensively in the information systems literature. For example, Davis and colleagues (1992) examined motivation in the context of computer use in the workplace. This research suggests that perceived usefulness is a proxy for extrinsic motivation when using a system, whereas enjoyment is a proxy for intrinsic motivation.

Intrinsic motivation has been linked to adoption and information system success. Venkatesh (1999) found that intrinsically motivated individuals (in the form of computer playfulness) positively affected acceptance of technologies. In this study, Venkatesh also demonstrated that specific training techniques aimed at increasing ones computer playfulness created a positive experience for the user and therefore increased the user’s satisfaction.

We advance the online consumer motivation research by offering a possible way to measure motivation based on interplay between the two factors (e.g. extrinsic and intrinsic motivation). True to SDT we view this interplay as a behavior continuum where one could be highly extrinsically motivated or highly intrinsically motivated. Clearly these two motivations factors are linked. For example, one could be highly extrinsically motivated and highly extrinsically motivated.

**ONLINE MOTIVATION**

Online consumer motivation is an emerging area of research that has received more and more attention recently. A review of online consumer motivation literature (C. M. Cheung, Chan, & Limayem, 2005; C. M. K. Cheung, Zhu, Kwong, Chan, & Limayem, 2003) has shown that online consumer motivation research draws heavily from the consumer behavior research including in an ecommerce context. This includes seminal research such as personality research (Folkes, 1988) and information processing (Bettman, 1979).

All of the above seminal theories have been used to describe of decompose online consumer behavior with some success. However, the application of these theories is not as simple of borrowing the respective components and applying them. It is clear, from this literature review that there are significant differences between online consumers’ motivations. We suggest, as does Malhotra, Zhang and others (Malhotra, Galletta, & Kirsch, 2008; Zhang, 2008), that IDT offers a simplistic parsimonious lens for understanding what consumers are looking for in an ecommerce transaction. Our conceptualization looks at the interplay between the intrinsic and extrinsic factors that may form a reasonable amount of influence over a consumer’s overall motivation when in an ecommerce context. For this reason it is important to investigate ways to measure this motivation.

**ONLINE CONSUMER MOTIVATION MODEL DEVELOPMENT**

As discussed above, we conceptualize that online consumer motivation can be measured by measuring the interplay between extrinsic and intrinsic motivation on a continuum. What is unclear is what specifically affects the extrinsic and intrinsic motivation in an ecommerce context. For this reason we must look at the past literature on individual/consumer characteristics.

In information systems the affect of individual or consumer characteristics have been identified as an important research perspective for quite some time (Zmud, 1979). These factors have included behavioral and motivation characteristics. In the case of our research there are two significant factors that we believe have significant impacts on motivation. The antecedents of online consumer motivation include the task (extrinsic forces / intrinsic forces) and individual difference in web use (extrinsic / intrinsic forces). These motivating factors have an obvious effect during the online experience. The following section outlines the antecedents and outcomes that are derivatives from the motivational factors in an ecommerce environment.
First we will look at how online tasks can be influenced by and also influence one’s motivation. This will include an introduction to past ecommerce studies on online tasks. Second, computer playfulness, a heavily studied motivational factor will be introduced and integrated into the online consumer motivation model.

Research on Online Tasks

In ecommerce consumers can have very different intentions and act different with different intentions. Some consumers have a general idea of what they are looking for while others have specific goals. For example, one user could be looking for cars without any specific requirement where another consumer could be searching for the best price for a certain used car that is located in her general vicinity. The extant ecommerce literature has identified two types of shopping tasks: 1) goal-directed and 2) experiential (Shang, Chen, & Shen, 2005; van der Heijden, 2004; van der Heijden, Verhagen, & Creemers, 2001; Wells, Palmer, & Fuerst, 2005). Unfortunately, there is no agreement for the terminology used in the consumer behavior and ecommerce literature.

As such, online ecommerce tasks can take many forms. Prior research has created online task categories (Hargittai, 2004; Kau, Tang, & Ghose, 2003; Rohm & Swaminathan, 2004). Further, the naming convention for these tasks has been somewhat inconsistent. Some researchers suggest that we differentiate tasks as “programmed” and “non-programmed” in an online environment (S. J. Simon, Grover, Teng, & Whitcomb, 1996), where programmed tasks are repetitive and routine and the non-programmed tasks are novel and unstructured. Other researchers identify the task on a continuum as “goal-directed” and “experiential” (Wells et al., 2005). Clearly, searching and browsing are deemed to be distinct activities in ecommerce, researchers also recognized that they represent two ends of a continuum rather than a strict dichotomy. There are several conventions used to describe the anchors on task continuum. Table 1 summarizes the task characteristics.

<table>
<thead>
<tr>
<th>Experiential Task Types</th>
<th>Goal-Directed Task Types</th>
<th>Key Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hedonic</td>
<td>Search attributes</td>
<td>Alba et al. [1997]</td>
</tr>
<tr>
<td>Unstructured</td>
<td>Utilitarian</td>
<td>van der Heijden [2004],</td>
</tr>
<tr>
<td>Non-directed search</td>
<td>Structured</td>
<td>Hoffman &amp; Novak [1997]</td>
</tr>
<tr>
<td>Non-linear navigation</td>
<td>Directed search</td>
<td></td>
</tr>
<tr>
<td>Perceptual attributes</td>
<td>Linear navigation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analytic processing</td>
<td>Mathwick et al. [2002]</td>
</tr>
</tbody>
</table>

Table 1: Task Characteristics: Experiential vs. Goal-Directed Directed (adapted from Wells 2005)

Next, we will introduce how individual differences, in the form of computer playfulness, can impact a consumer’s online motivations.

RESEARCH ON INDIVIDUAL DIFFERENCES

There are many different way of examining how individual differences relate to ecommerce outcomes. Specific individual differences examined in the consumer behavior and ecommerce literature include privacy beliefs (Sheng, Nah, & Siau, 2008), usability preferences (Palmer, 2002), interactivity preferences (Campbell & Wright, 2008), cognitive load (Shang et al., 2005), stimulation preferences (Hirschman & Holbrook, 1982) and so on.

As stated above it is our contention that task is an important component that affects motivation, be it intrinsic or extrinsic. Independent of task, the consumers interaction with an ecommerce web site seemed to be influenced by the inherent nature of the user (Goodhue, 1995; Goodhue & Thompson, 1995).

We believe that similar to differences in tasks (experiential and search), users can also have intrinsic or extrinsic preferences for online experiences. More specifically, we believe that online shopping motivations can vary from person-to-person in general. Zhou (2007) agrees by stating, “(intrinsic) shoppers always find more enjoyment in interactivity environments than in pure test environments.” (Pg. 41). On the other hand, research has shown that extrinsic shoppers are concerned with the shopping experience being timely, quick and efficient (Childers, Carr, Peck, & Carsond, 2001).

It is obvious that the influence of computer playfulness will account for a different degree of effect on motivation when the task changes. The literature has posited that aspects of the task will account for more variance in outcomes than some individual differences (H. A. Simon, 1996). What is not certain, and will be studied here, is how computer playfulness and the task will influence overall online motivation in an ecommerce environment.

For this reason we conceptualize online consumer motivation as a second order factor that is influenced by both task type (search or experiential) and computer playfulness (intrinsic and extrinsic). Figure 1 depicts our
conceptualization of how online consumer motivation is formed. This includes the effects of both task and computer playfulness.

![Diagram](image)

**Figure 1. Online consumer motivation**

In order to measure the constructs developed in this paper, instrumental validation should precede any empirical validation of the hypothesis (Cook & Campbell, 1979). The instrument vetting process refers to the adequacy with which items (e.g. questions) address the and are related to the construct for which they represent (Straub, Bourdreaux, & Gefen, 2004). The information system literature offers explicit guidance on validation guidelines for measurement instruments (Gefen, Straub, & Bourdreaux, 2000; Straub, 1989; Straub et al., 2004).

**Final Research Model**

A measurement model was tested and the 3 factors were discriminant and convergent based on the current methods. Due to space limitations much of the methods section had to be removed in this research-in-progress paper. The structural model was also tested. As stated above we are testing to see if the perceptions of the task and an individual’s computer playfulness affect online consumer motivation. As before, AMOS 16.0 was used to test the model. As seen in Figure 2 below the model produced good fit for each indices. Further, all paths in the model were significant. Below is recommended instrument (See Table 2).

| OCM1 | I am likely to play while using this web site. |
| OCM2 | I would like to enjoy myself while interacting with this web site. |
| OCM3 | I am inclined to explore this web site. |
| OCM4 | I am likely to tinker while interacting with this web site. |
| OCM5 | I am inclined to spend some time and look around this web site. |
| TT1  | Directed/Meandering |
| TT2  | Well-Organized/Unordered |
| TT3  | To-the-Point/ Browsing |
| TT4  | Direct/Not Direct |
| TT5  | In-and-out/ Look around |
| CP1  | . . . unimaginative |
| CP2  | . . . creative |
| CP3  | . . . playful |
| CP4  | . . . unoriginal |
| CP5  | . . . uninventive |

**Table 2: Scales**
DISCUSSION & CONCLUSION

This paper provides insight into the critical psychological factors that affect online consumer behavior. Further, this paper develops and validates an instrument to measure the factors that are attributed to online consumer motivation in an ecommerce context. The development of an online consumer motivation instrument is useful as it will allow researchers and practitioners alike to be able to measure and therefore predict which web design tools will but suit the consumer.

The contributions of this paper are two-fold. First a conceptual model of the factors influencing online consumer motivation is presented. This model draws on SDT as well as the current practices used in web design. The model adapts concepts from SDT (Deci, 1975; Deci & Ryan, 1985; Ryan & Deci, 2000), and references several components of use of motivation in design (Fang & Salvendy, 2000; Galletta et al., 2006; Palmer, 2002; Zhang, 2008). Second, this paper presents an instrument that has been validated in a laboratory tests. The results show both discriminate and convergent validity for the measurement instrument based on both an exploratory and independent confirmatory sample. One limitation of this study is that subjects used in the analysis. Student subjects were used in the initial sample. This limitation was controlled somewhat as the task that was executed mapped to the subjects’ everyday experience. In other words, using student subjects to research online shopping and online consumer behavior can be seen as acceptable, as they are part of the core online shopping demographic.

REFERENCES

ABSTRACT

In less than a decade, XBRL (eXtensible Business Reporting Language) has become a standard for reporting financial data in an XML format. This paper is an introduction to XBRL, the technical documents needed to accomplish the reporting, potential problems found in current reporting mechanisms, and future directions for use of XBRL.

Keywords
XBRL, Financial Reporting, Information Systems, XML

INTRODUCTION

XBRL had its beginning in April 1998 when Charlie Hoffman began investigating the use of XML for electronic reporting of financial information. His experimental prototype of XBRL was completed by October 1999. In July of 2000 the first XBRL specification for financial statements for commercial and industrial companies was released. At that time, the formation of an international organization to expand XBRL globally for adoption. After the first international XBRL conference was held in London in 2001, XBRL was modified to reflect the World Wide Web Consortium (W3C) recommendations which allowed all XML efforts to be consistent and use common software tools. (XBRL International, n.d.)

Today, XBRL International has eighteen established jurisdictions (Australia, Belgium, Canada, Denmark, France, Germany, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, South Africa, Spain, Sweden, UAE, United Kingdom, United States) and four provisional jurisdictions (China, India, Poland, Switzerland) whose responsibilities are to focus on the progress of XBRL in their region. On June 15, 2009, the US Security and Exchange Commission’s XBRL Mandate went into effect for 10-Ks filed on or after that date.

A number of Internet technologies are used to deploy XBRL. Those recommended by the W3C are listed in Table 1.

<table>
<thead>
<tr>
<th>Technology</th>
<th>URL</th>
<th>W3C Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>XML: eXtensible Markup Language</td>
<td><a href="http://www.w3.org/TR/REC-xml/">http://www.w3.org/TR/REC-xml/</a></td>
<td>XML 1.0 (Fifth Edition)</td>
</tr>
<tr>
<td>XML Schema: used to formally describe the data of a XML document</td>
<td><a href="http://www.w3.org/XML/Schema/">http://www.w3.org/XML/Schema/</a></td>
<td>XML Schema 1.1</td>
</tr>
<tr>
<td>XML Namespace: provides a method to create logical groupings of elements, avoiding name conflicts</td>
<td><a href="http://www.w3.org/TR/REC-xml-names/">http://www.w3.org/TR/REC-xml-names/</a></td>
<td>Namespaces in XML 1.0 (Third Edition)</td>
</tr>
<tr>
<td>XLink: a standard way of hyperlinking XML documents together</td>
<td><a href="http://www.w3.org/TR/xlink/">http://www.w3.org/TR/xlink/</a></td>
<td>XML Linking Language (XLink) 1.0</td>
</tr>
<tr>
<td>XSLT: a language to transform XML documents into other XML documents (and particularly useful for creating XHTML documents to format XML data)</td>
<td><a href="http://www.w3.org/TR/xslt">http://www.w3.org/TR/xslt</a></td>
<td>XSL Transformation (XSLT) Version 1.0</td>
</tr>
<tr>
<td>XPath: a language for navigating and finding information in a XML document</td>
<td><a href="http://www.w3.org/TR/xpath/">http://www.w3.org/TR/xpath/</a></td>
<td>XML Path Language (XPath) Version 1.0</td>
</tr>
<tr>
<td>XQuery: a language for querying (extracting data) from XML data</td>
<td><a href="http://www.w3.org/TR/xquery/">http://www.w3.org/TR/xquery/</a></td>
<td>XQuery 1.0: An XML Query Language</td>
</tr>
</tbody>
</table>

Table 1. XBRL Technology Recommendations from W3C

We find the vocabulary of XBRL, based on its accounting background, are different that the vocabulary found in traditional information technology. Hoffman (2006) describes the basic XBRL terminology in use today, found in Table 2.
This paper will be organized as follows. We begin by looking at an example of data transformation into technical documents necessary for XBRL reporting. Next, we will look at current software support for XBRL Instance Documents used for financial reporting, as well as potential problems that have been identified with XBRL reporting. We will conclude with some comments made in an interview with Charles Hoffman, the originator of XHRL and one of the principal leaders in the XBRL movement, regarding his vision of the future of XBRL, as the creator of the initiative.

**TECHNICAL TRANSFORMATION OF FINANCIAL DOCUMENTS**

Current XBRL taxonomies that have been finalized and are available for use in the United States jurisdiction are found at http://xbrl.us/taxonomies/Pages/default.aspx:

- Mutual Fund Risk/Return Summary, Release 2008: Represents the Risk/Return Summary portion of SEC Form N-1A according to the final rule 33-8998.
- US GAAP Investment Management Taxonomy: Intended to provide detail level accounting terms and reporting structures required by certain US GAAP-based investment management companies in order to tag financial statements in XBRL.

In order to better understand the type of conversion from financial document to an XML Schema and XML, we look at an example, excerpted from Charlie Hoffman’s *Hello World* example, found at www.xbrlsite.com. The sample spreadsheet,
• Context: The context sets the date for the information contained in the financial report.
• Units: The financial report is in USD, which is in the iso4217 namespace.
• Fact Values: Values for Land and BuildingsNet are included. Both of these elements are prefixed with the hw namespace, that is declared in the <xbrl> root element.

The Instance (XML) Document would be transmitted to a government agency for financial reporting. Enough information, however, may be found in the Instance document so that XSLT could be easily used to recover the information to produce a usable financial report that can be displayed as XHTML.

```xml
<?xml version="1.0" encoding="utf-8"?>
<!-- HelloWorld Example -->
<schema
xmlns="http://www.w3.org/2001/XMLSchema"
xmlns:xbrli="http://www.xbrl.org/2003/instance"
xmlns:link="http://www.xbrl.org/2003/linkbase"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:hw="http://xbrl.squarespace.com/HelloWorld"
targetNamespace="http://xbrl.squarespace.com/HelloWorld"
elementFormDefault="qualified"
attributeFormDefault="unqualified">
  <import
    namespace="http://www.xbrl.org/2003/instance"
  <element
    name="Land"
    type="xbrli:monetaryItemType"
    substitutionGroup="xbrli:item"
    xbrli:periodType="instant" />
  <element
    name="BuildingsNet"
    type="xbrli:monetaryItemType"
    substitutionGroup="xbrli:item"
    xbrli:periodType="instant" />
</schema>
```

Figure 2. Sample XML Schema for Example Company

SOFTWARE SUPPORT FOR XBRL INSTANCE DOCUMENT CREATION

An examination of twenty vendor websites offering software tools for the creation of XBRL instance documents was made in December 2009. These vendors were all registered and listed with XBRL International. In examining the instance document creation capabilities of the software, a wide variety of input, instance, document creation and validation was noted. The functionalities commonly found throughout the vendor offerings included:

• Pre-formatted report generation.
• Vendor-created forms for data input.
• Ability to create custom forms for data input.
• Data Combination from multiple sources (spreadsheets and databases).
• Creation of XML Instance Documents from spreadsheets.
• Input and output using CSV files.
• Tagging data for multiple uses in Instance Documents.
• Custom data validation.
• Graphical creation of Instance Documents.
• Valuation and funding calculations.
• Support for Java and .NET framework custom application development.
For the relatively rich set of functionalities available from the approved software vendor list, Bartley, Chen & Taylor (2009) found a number of errors in 10-K reporting from the 2006 voluntary filing program that began as a pilot program before the July 15, 2009 XBRL filing mandate. Errors in number signage, amounts, labeling and classification were found. These errors were considered to be potentially serious because users would not visually recognize the problems.

Figure 3. XML Instance Document for Example Company

THE FUTURE DIRECTION OF XBRL REPORTING

In a recent interview with the authors, Charles Hoffman (Personal Communication, 2009) notes the majority of practitioners involved in XBRL, up to and including XBRL International, have a current focus on the deployment and initial compliance reporting with XBRL. Once technological challenges have been overcome, the real power of XBRL will become unleashed.

Hoffman explains originally developed the idea of XBRL to support information modeling and sharing between peers in management. The purpose is to allow this sharing and comparison of information without the need for costly information systems personnel. He went on to explain this paradigm with the common electronic spreadsheet. The logical model of a spreadsheet is a grid of rows and columns. Through this model, financial information can be created and easily exchanged. However, the flexibility of the spreadsheet logical model has both advantages and disadvantages. The advantage is the rich set of possibilities of modeling. The disadvantage is the lack of similar structure, often making the interchange, comparison and use of information between peers somewhat difficult.

As businesses and regulatory agencies begin to overcome the technical difficulties of implementation and potential errors, Hoffman hopes a major logical model will begin to appear that can be used throughout all regulatory agencies and businesses. Unfortunately, in these early stages, each regulatory agency is tending to construct its own proprietary logical model, making the idea of information sharing somewhat difficult.
Another current issue is that, while (for example) the SEC has collected large amounts of XBRL-formatted data about companies, there is little use of this data to compare and contrast company financials and performance - exactly the purpose of XBRL. However, Hoffman feels this is a problem that will be overcome as new software tools are developed to process and analyze the vast amounts of XBRL data that are being and have been collected. Hoffman projects that "magic" should ultimately happen when two businesspeople can exchange information using XBRL without the help of I.T. or other systems personnel.

![Figure 4. The XBRL Pyramid Model](image)

Figure 4 shows the authors’ conceptual model based on the discussion with Hoffman. In this model, the business users are able to share data independently of the technical concerns of the XBRL standards, the creation of the Instance Documents, and the information technology personnel necessary to create and maintain the repository.

**CONCLUSION**

The reporting of financial information has made great strides with the recent required adoption of XBRL by the US Securities and Exchange Commission. Software tools are becoming more prevalent to ease the burden of the current deep technology stack that many accounting firms are finding with the XBRL Mandate. While there are some initial inaccuracies and “bumps along the road,” a unified XML format for financial reporting will provide a smoother and more automated foundation for reporting and comparisons of corporate financial data.

**ACKNOWLEDGMENTS**

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