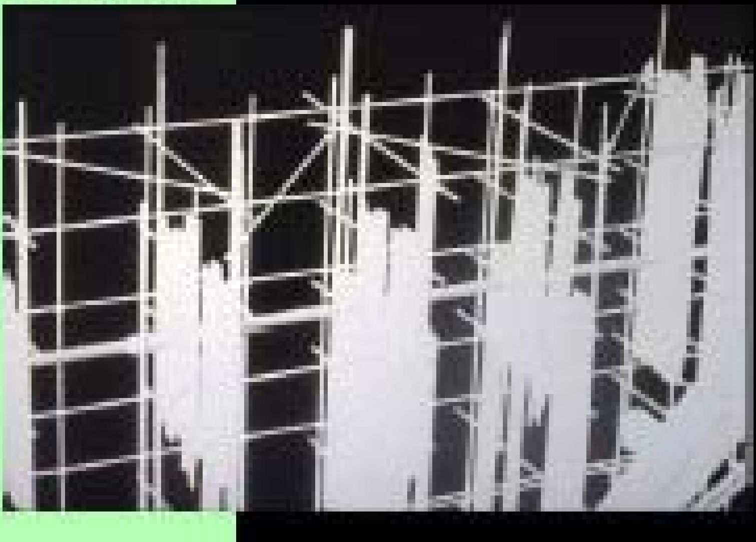
Advanced Topics in Information Resources Management

Volume 2



Mehdi Khosrowpour

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Advanced Topics in Information Resources Management

Volume 2

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Preface

Information management has many facets, and the emerging world of electronic business and virtual communities makes the tasks associated with effective information management even more complex. From knowledge management to virtual teams and from IT investments to organizational mission statements, business executives, IT practitioners, researchers, teachers and students need to have access to the most current information surrounding the research and practice of information resources management. The chapters offer the most current theory and practice in IT research and management. These chapters, all written by experts in their respective fields offer concrete suggestions for managers and individuals who want to get the most from their IT investments, secure their privacy on the Internet and effectively manage their knowledge resources. For the academics and researchers, these chapters offer novel theory of evaluating information systems. From postmodernism to Chaos Theory, these chapters are designed to provoke thoughtful discussion and novel research paradigms.

Chapter I, entitled "Aligning IS Research and Practice: A Research Agenda for Virtual Work," by France Bélanger, Mary Beth Watson-Manheim and Diane H. Jordan, explores the emerging area of virtual work. This chapter develops a new and broader research agenda that accounts for emerging issues and concerns of practitioners, existing published work and interdisciplinary perspectives in the area of virtual work. The authors of this chapter offer an intriguing discussion of the emerging trends in virtual work and the necessary supporting technologies.

Chapter II, entitled "The Societal Impact of the World Wide Web — Key Challenges for the 21st Century," by Janice M. Burn and Karen D. Loch, addresses the impact of information technology and the World Wide Web on the 21st century and the challenges that responsible members of a dynamically changing society face in light of these new technologies. The authors argue that organizational, sociological and cultural factors may inhibit an effective transformation to a global information society and pay particular attention to the policies, infrastructure, human resources and development responsibilities in developing countries.

Chapter III, entitled "Internet Privacy: Interpreting Key Issues" by Gurpreet S. Dhillon and Trevor T. Moores, identifies issues related to maximizing Internet privacy. This chapter describes the notion of Internet privacy and offers various researchers' definitions of it. The authors then describe their research, which sought to define the major Internet privacy concerns. The chapter presents five major areas of concern, and the authors offer the recommendations for ensuring privacy in the Internet age.

Chapter IV, entitled "Knowledge Management Enablers within an IT Department," by Hope Koch, David Paradice, Yi Guo and Bongsug Chae, presents a case study of knowledge management efforts within an information technology environment. The case study is based on technical and human-centric approaches combined with Holsapple and Joshi's Kentucky Initiative. Based upon the case study presented, the authors propose a model of execution of knowledge manipulation activities and a model outlining factors enabling effective knowledge management.

Chapter V, entitled "E-mail's Value: Internal versus External Usage," by Denise J. McManus, Chetan S. Sankar, Houston H. Carr and F. Nelson Ford, provides a new perspective on the competitive advantage of electronic mail within organizations. This chapter investigates the relationship between the strategic uses and competitive benefits of electronic mail in modern organizations. The results suggest that e-mail usage could augment the competitive posture of the firm.

Chapter VI, entitled "The Value of Managerial Flexibility in Strategic IT Investment: Identify the Real Options of Resource Allocation," by Xiaotong Li and John D. Johnson, discusses the real options theory and its application to IT investment evaluation. The authors provide a framework that systematically justifies using real options theory in Strategic IT investment evaluation. The authors discuss an electronic brokerage's investment decision in wireless technology as a real-world application of the proposed framework.

Chapter VII, entitled "Trust and Technology in Virtual Teams," by Steven A. Morris, Thomas E. Marshall and R. Kelly Rainer, Jr., investigates the impacts that reliance on information technology and trust have on job satisfaction of virtual team members. The study presented in the chapter reveals that both user satisfaction and trust are positively related to job satisfaction in virtual teams, while system use was not found to play a significant role.

Chapter VIII, entitled "An Architecture for Active and Passive Knowledge Management Systems," by Stuart D. Galup, Ronald Dattero and Richard C. Hicks, discusses the importance of utilizing a knowledge management system which allows for knowledge management activities that utilize both active and passive knowledge. This chapter develops and justifies a proposed client/server architecture to build a manageable active knowledge management system that uses digital forms of both active and passive knowledge.

Chapter IX, entitled "Social Issues in Electronic Commerce: Implications for Policy Makers," by Anastasia Papazafeiropoulou and Athanasia Pouloudi, examines how social concerns such as trust and digital democracy pertain to all levels of Internet and electronic commerce policy. The authors then discuss dilemmas facing and influencing the development and construction of an effective and socially responsible strategy for electronic commerce.

Chapter X, entitled "Information Technology Outsourcing in Australia," by Nicholas Beaumont and Christina Costa, reports a research project investigating the incidence of outsourcing among Australian firms. The authors conclude that the three most important factors for driving outsourcing in Australia are access to skills, improved service quality and increasing mangers' ability to focus on core business activities. The chapter concludes by offering suggestions for successful outsourcing partnerships.

Chapter XI, entitled "Exploring the Influence of Rewards on Attitudes Towards Knowledge Sharing," by Gee Woo (Gilbert) Bock and Young-Gul Kim, describes the results of a study that examines and tests factors expected to affect an individual's knowledge-sharing attitudes, intentions and behaviors in an organizational context. The chapter discusses the major detriments towards knowledge sharing and the influence of a positive attitude towards knowledge-sharing behaviors.

Chapter XII, entitled "Intentions to Use Groupware: The Influence of Users' Perceptions," by Craig Van Slyke, Hao Lou and John Day, presents the results of a study using diffusion of innovation theory to investigate the factors that influence intentions to use a specific groupware application, Lotus Domino discussion database. The authors offer suggestions for positively impacting users' perceptions and increasing the use of groupware applications.

Chapter XIII, entitled "The Influences of the Degree of Interactivity on User-Outcomes in a Multimedia Environment: An Empirical Investigation," by William D. Haseman, Vichuda Nui Polatoglu and K. Ramamurthy, investigates the influence of interactivity on the learning outcomes of users in a multimedia systems environment. The results of the study discussed indicate that while interactivity does not necessarily enable a gain in user learning, it does positively influence participants' attitudes. The study further demonstrates that there are no moderating effects of learning styles, as measured by Kolb's Learning Style Inventory scale, on the relationship between interactivity and user outcomes.

Chapter XIV, entitled "On the Role of Human Morality in Information System Security: From the Problems of Descriptivism to Non-Descriptive Foundations," by Mikko T. Siponen, proposes that the use of ethical theories and human morality is useful for security, and further argues that descriptivism, including cultural relativism, leads to several problems and contradictions, and causes detrimental effects to well-being and security. The authors propose an alternative approach to using ethics that is based upon non-descriptive theories.

Chapter XV, entitled "Chaos Theory as a Framework for Studying Information Systems," by Gurpreet S. Dhillon and John Ward, introduces Chaos Theory as a means of studying information systems. The chapter argues that new techniques, derived from Chaos Theory and used for discovering patterns in complex quantitative and qualitative evidence, offers a more sustentative approach to understand the nature of information systems.

Chapter XVI, entitled "Organizational Mission Statements: A Postmodernist Perspective on the Management of an IS/IT Function," by John Pillay and Ray Hackney, examines postmodernism in the context of organizational mission statements and forms a critique of modernist approaches and proposes alternative views about philosophy, organizational management theory and IS/IT management theory. The authors conclude that the modernist/postmodernist dialectic is a productive discussion, which positively contributes to IT research in terms of analytical techniques and interpretive strategies.

Effective and efficient management of information and knowledge resources is priority for organizations of all types and sizes, and for individuals. The increasing importance of the virtual world is revolutionizing the way businesses and organizations relate to each other. In order to be successful in this technological world, organizations, researchers, teachers, students and individuals must have access to the most current research into the theory and practice of information management. Academics and researchers will find the research proposed an excellent starting point for discussions and springboard for their own research. Practitioners and business people will find concrete advice on how to maximize their IT investments, their knowledge management initiatives and their training programs. This timely new book is a must-read for anyone interested in gaining a better understanding of how to successfully manage and improve their valuable technology and information resources.

Mehdi Khosrow-Pour
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January 2003

Chapter I

Aligning IS Research and Practice: A Research Agenda for Virtual Work[1]

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ABSTRACT

Recent advances in information technologies have led organizations to diversify their organizational structures. One of the most prominent trends in this diversification is to conduct work in distributed or virtual environments. Distributed work alternatives are numerous, but the common characteristic that defines these alternatives is the physical separation of employees from each other and/or their organization's workplace. Several corporations have reported their efforts, successes and failures at implementing some form of distributed work. Practitioners face a number of issues when considering *virtual work alternatives. However, research does not seem to successfully help in understanding and solving some of these key issues. This chapter attempts to develop a new and broader research agenda that takes into account emerging issues and concerns of practitioners, existing published work and interdisciplinary perspectives on the topic. In doing so, emerging trends in virtual work and supporting technologies are explored.*

INTRODUCTION

Virtual or distributed work environments are increasingly employed by organizations. These environments include geographically distributed work teams, global project teams, inter-organizational teams and non-traditional work environments such as virtual organizations, telecommuting (telework), hoteling and satellite work centers. While there is increased complexity and potential for problems, virtual work strategies allow organizations a great deal of flexibility to compete in a rapidly changing business environment. Existing research provides insights into distributed work environments, but does it deal with the major concerns and issues faced by managers? What problems need to be addressed before organizations can take better advantage of today's technologies in distributing their workforce? It seems that research has not been successful at understanding and solving some of the key issues that practitioners face when considering virtual work alternatives ("the gap").

A gap between research and practice has always existed since the two areas' interests have different roots. Practicing managers are concerned with current challenges in their particular work settings, while academics are concerned with developing more generalizable rules and understanding. In addition, there is an inherent time lag between the surfacing of challenges in the day-to-day activities of managers and the development of academic research addressing these concerns and challenges. While academics focus on understanding virtual work environments and practitioners focus on managing these environments, our discussions and research about this gap reveal that it is inappropriately large. This chapter has three objectives: 1) to examine the gap between research and practice in virtual work; 2) to investigate the factors leading to this gap; and 3) to identify a research agenda to address emerging issues and concerns relevant to practice in virtual work. We proceed by identifying current concerns of practitioners through descriptions of two companies' virtual work environments. We compare them with published research to establish the extent of the gap and then investigate the reasons for this gap.

METHODOLOGY

Our study includes three steps. First, we reviewed the recent literature on virtual work and included a discussion of early work in the area of telecommuting and telework. Second, we compared the topics identified in our literature review with issues raised by practitioners in two organizations. Finally, we identified and discussed the gap found between the two views (academic and practitioner), and developed an agenda for future research.

VIRTUAL WORK LITERATURE

One of the biggest problems in conducting or discussing research on distributed work is the abundance of definitions and terms used interchangeably (Bélanger & Collins, 1998; McCloskey & Igbaria, 1998; Pinsonneault & Boisvert, 2001). While there are other distributed work arrangements such as hoteling, neighborhood work centers and flextime, most of the literature has focused on telecommuting (telework) and virtual teams/organizations. There is overlap between these terms, and this is part of the difficulty with conducting research in the area. We use the term "virtual work" to represent work environments where individuals spend some time working in non-face-to-face (FTF) mode, using information and communication technologies to perform work activities.

In order to identify relevant academic research on telework and virtual work, we employed two different methods. First, we searched a number of sources for articles. We performed searches on ABI/Inform using the keywords *virtual work, distributed work, telework* and *telecommuting*. We concentrated on the years 1998 to 2001 since research prior to 1998 has been summarized in several recent literature reviews (discussed in a later section). We focused on mainstream IS journals targeted to the MIS community.[2] In addition, we investigated the Academy of Management journals and *Organization Science*. Finally, we included special issues of several journals and books published between 1998 and 2001.

Second, we used the "snowball" technique where we mined citations in articles for further references. We did not include the large number of papers presented at conferences.

Other studies relevant to teleworking and virtual work can be found in the transportation, organizational behavior, ethics, law, sociology and communication literatures. We limited our sample to employees of organizations who perform their work at home, or in other remote work settings during at least some normal business hours. Therefore, studies of home-workers and entrepreneurs are not included, nor

Table 1: Review of Recent Literature – Summary

Authors	Type of Research	Methodology	Sample	Key Concepts
Adam 2001	Empirical	Survey & interviews	14 organizations & 20 teleworkers	Provides descriptive statistics on the use of teleworking in Ireland.
Ahuja & Carley 1998	Empirical	Analyzed e-mail messages from a 3-month period	Researchers, graduate students & staff at various universities & corporations	Studied communication patterns. Found that hierarchical tendencies emerged. Also degree of task routineness influenced development of hierarchical tendencies (more routine led to more hierarchy).
Bélanger & Collins 1998	Conceptual	Literature review	7 empirical hypothesis-driven & 25 empirical not hypothesis-driven studies	Presents literature before 1998 and discusses need for proper definitions. Proposes a framework where organizational, individual, work and technology characteristics must fit together in affecting telecommuting outcomes (at societal, organizational and individual levels).
Bélanger 1999	Empirical	Survey & interviews	76 telecommuters & non-telecommuters	Discusses reasons individuals opt not to telecommute. Choice is significantly impacted by job type and age of individuals. Telecommuters report higher perceived productivity and personal control than non-telecommuters.
Bélanger 1999b	Empirical	Survey	75 co-workers including some telecommuters	Using network analysis, studied whether non-telecommuters form their own cliques, with telecommuters being left out of office network. Results indicate that telecommuters and non-telecommuters do not form separate groups, and that only job type tends to indicate clique or sub-group membership.
Bélanger et al. 2001	Empirical	Survey	8 work groups in 6 organizations; 67 telecommuters & 33 non-telecommuters	Availability of information system and communication technologies positively impact productivity, performance and satisfaction of telecommuters. The fit (interaction) between information systems and communication technologies available reduces the positive impact of technologies on productivity. The level of workgroup communication negatively affects perceived productivity and performance.
Boudreau et al. 1998	Conceptual	Informal review of literature	------	Addresses virtual transnational organizations. Proposes framework to match information technologies to requirements of virtual transnational organizations for efficiency, responsiveness and learning.
Cascio 2000	Conceptual	Informal review of literature	------	Identifies and examines different forms of virtual workplace. Propose management guidelines. Most important to shift from emphasis on time to emphasis on results, and require better supervisory skills from managers. Number of managers needed should not decrease.

Table 1: Review of Recent Literature – Summary (continued)

Dimitrova & Salaff 1998	Empirical	Survey	94 teleworkers in 1 firm	Employees with more complex, interdependent networks and who deal in "softer," more political information rely most on phone communication; others rely most on e-mail.
Dixon & Webster 1998	Empirical	Survey	119 telecommuters	Higher organizational support results in lower stress levels. Stress has strong inverse relationship with quality of work & non-work life. Telecommuters & non-telecommuters report similar stress levels, but from different source.
Duxbury 1998	Empirical	Survey	2 departments	Part-time telework arrangements do not seem to impact intra-organizational communications.
Duxbury & Neufeld 1999	Empirical	Survey	36 teleworkers, 28 managers, 27 co-workers, 25 in control group	Teleworkers did not differ from the control group in terms of frequency with which they communicated with managers, subordinates, co-workers and clients.
Duxbury et al. 1998	Empirical	Surveys & interviews at two time periods	54 telecommuters, 26 managers, 22 co-workers, 36 in control group	Teleworkers had significant difference in work-family conflict over time with lower levels of interference of family to work and work to family, and fewer problems managing family time than before telework pilot. Control, co-worker and manager groups had no significant differences. Telework can help balance work and family demands.
Goodman & Darr 1998	Empirical		60 sites of Fortune 100 company	Investigated organizational learning in distributed environment. Found that technology was not well-suited for complex problems. Alternatives such as meetings were best to filter best practices.
Grabowski & Roberts 1998	Conceptual	Literature review	-------	Investigated virtual organization risk propensity. Identified 4 factors that mitigate risk propensity: organizational structuring and design, communication, culture and trust.
Guthrie & Pick 1998	Empirical	Survey	134 managers & professionals	Presented with 18 telecommuting scenarios, opinions of respondents revealed that there were no differences in their views of telework and work ethics as a function of organizational level, telecommuting experience and gender.
Guimaraes & Dallow 1999	Empirical	Survey	316 telecommuters in 18 companies	Characteristics of supervisors, employees, tasks and work environment, management support and problems encountered affect telecommuting success.

Table 1: Review of Recent Literature – Summary (continued)

Harrington & Ruppel 2001	Empirical	Survey	125 IS managers	Investigated effects of practical compatibility and values compatibility on telecommuting adoption, diffusion and success. Findings indicate that ability to secure telecommuting and developmental values affect adoption and diffusion of telecommuting, group values affect diffusion and success of telecommuting, and practical compatibility and rational values affect telecommuting success.
Harrington & Ruppel 1999	Empirical	Survey	111 IS managers	Measured effects of trust, corporate culture (4 levels), practical compatibility and relative advantage on telecommuting adoption, diffusion and success. Trust affects adoption and diffusion, relative advantage affects all 3 outcomes and various levels of corporate culture affect the 3 outcomes.
Hightower et al. 1998	Empirical	3 experiments	Students in 3-person groups; number of groups unknown	Discusses the effects of Computer Mediated Communication Systems (CMCS) on information exchange in groups. Findings indicate that ad hoc virtual groups exchange information less effectively than face-to-face groups. Ongoing virtual groups exchange information more effectively than ongoing face-to-face groups.
Igbaria & Guimaraes 1999	Empirical	Survey	400 salespeople in 1 large organization; compared answers of telecommuters & regular employees	Examined the role of the work environment on turnover intentions, role stressors, e.g., role ambiguity and role conflicts, job satisfaction and organizational commitment. Found that telecommuters seemed to have less role conflict, exhibited higher job satisfaction and were more committed to the organization.
Jarvenpaa & Leidner 1999	Empirical	Case studies (e-mail archives, questionnaires)	350 Master's-level students from 28 universities around the world	Trust in temporary global virtual teams. Does it exist, how is it developed, what communication behaviors facilitate development of trust? Found that if trust is developed, it is early in the life of the team—"swift trust."
Jarvenpaa et al. 1998	Empirical	Content analysis of interactions over 8 weeks	75 teams comprised of 4 -6 students residing in different countries	Examined antecedents of team trust development. Early phase of team development, trust influenced strongest by perception of members' integrity and least by perception of benevolence. Influence of perception of ability of members on trust decreased over time.
Johnson 2001	Empirical	Case	1 organization (St. Paul Companies)	Case looks at St. Paul Companies' use of the virtual office. Overall use of telecommuting is positive, and there is a recognition of the need for more training.
Kavan & Saunders 1998	Empirical	Survey	1 organization, several managers	Employee approval and suitability of the alternative work arrangement programs correlate significantly to the likelihood of their adoption. Managers with lower performance on budgets and employee satisfaction tend to view the adoption of part-time and job-sharing programs as more likely.

Table 1: Review of Recent Literature – Summary (continued)

Knight & Westbork 1999	Empirical	Survey	20 teleworkers	Found that Hertzberg's motivation factors (achievement, recognition, work itself, responsibility, advancement and growth) apply to teleworkers.
Knoll & Jarvenpaa 1998	Empirical	Content analysis, surveys & interviews	Study 1: 12 teams (84 students); Study 2: 7 teams (30 students)	Collaboration, conflicts, communication and socialization in virtual teams (using electronic mail).
Kraut et al. 1999	Empirical	Telephone survey	Senior managers in 250 firms	Coordination in supply chain. What are mechanisms for coordination? Personal relationships complement electronic coordination mechanisms/networks. Firms more likely to use e-mail than computer networks for exchanging documents; use of networks associated with poor outcomes in working with suppliers.
Lind 1999	Empirical	Survey	29 virtual groups of 4 & 1 virtual group of 5 students	Looked at perceptions of face-to-face vs. virtual groups based on gender. In virtual groups, women perceived that the groups stuck together more than the men, and were more satisfied and found group conflicts to be more readily resolved than men. Face-to-face women were less satisfied with group experience than virtual counterparts.
Majchrzak et al. 2000	Empirical	Observations, surveys, content analysis, in 10-month longitudinal study	1 inter-organizational virtual team	Knowledge sharing through communication technology. Found that CT use decreased over time, but is used more when collective understanding is required. Knowledge sharing is more complex than current models predict. Sharing of different types of knowledge—content and process—differs depending on context-specific needs.
Maznevski & Chudoba 2000	Empirical	Qualitative longitudinal field study, multiple data-gathering methods	3 globally distributed teams in 1 organization; 2 of 3 teams had members from outside organization—a strategic partner	Influence of structural characteristics of teams (task, group and technology) as antecedents of the influence of team interactions (decision processes, message complexity and form) on performance outcomes. Effective interaction is composed of multiple incidents, which fit different aspects of team's structural characteristics. Also, face-to-face communication was critical, often essential, to effective performance; and communication regularity influenced effectiveness.
McCloskey & Igbaria 1998	Conceptual	Literature review	32 studies	Review of telecommuting literature revealed only 32 empirical studies. Studies include pilot studies, usage studies, beliefs/perceptions studies, work attitudes/outcome studies and family issue studies. Issues include definitions of telecommuting, methodological weaknesses and lack of control of extraneous factors.

Table 1: Review of Recent Literature – Summary (continued)

McCloskey 2001	Empirical	Survey	89 telecommuters & 71 nontelecommuters	Telecommuters report more autonomy, less time-based work-family conflict and receiving less career-support than non-telecommuters.
Palmer 1998	Empirical	Survey	55 technology managers	Use of IT is different in virtual organizations than virtual teams in regular organizations. Greater use of Web but lower use of groupware, EDI and e-mail.
Pinsonn-eault & Boisvert 2001	Conceptual	Literature review		Starts by reviewing definitions. Identifies all positive and negative impacts of telecommuting for organizations and individuals.
Reinsch 1999	Empirical	Quasi-experiment	104 telecommuters	Communication behaviors and relationship duration affect participation in a telecommuting program. Managerial reaction to criticism and managerial loyalty significantly affected forecasts of the worker's and manager's working together successfully.
Ruppel & Howard 1998a & 1998b	Empirical	Survey	252 IS managers	Top management support, champions, adequate security measures and manager training were positively related to telework adoption ad diffusion.
Scott & Timmer-man 1999	Empirical	Survey	86 teleworkers	Investigated relationship between teleworkers demographics, communication technology use, identification and level of virtuality of teleworkers. Found non-linear relationship between level of telecommuting and identification with team, organization and occupation. Moderate levels of telecommuting (21-50% of the time) have higher levels of identification. Some demographics also impact communication technology use or identification.
Staples 2001	Empirical	Focus groups	5 organizations, 19 focus groups & 104 people (appx.); half managers, half teleworkers; follow-up survey of 631 managers & employees	The main issues in management of remote workers were identified using two different scores. The top issues were communications, performance management, coaching, information technology and isolation. Survey results indicate the strongest predictor of effectiveness of telecommuting include managers' ability to assess performance based on results and communicating goals and setting priorities, employees' ability to set objectives that align with their managers' and the length of time employees have worked for their managers.
Staples et al. 1999	Empirical	Questionnaire	376 remotely managed employees in 18 diverse organizations	Investigated management of remote employees using self-efficacy theory. Found that training, IT support and work experience are important for individuals working remotely.

are studies of supplemental work at home. Finally, in selecting our sample we focused on empirical and/or theoretically grounded studies.

Table 1: Review of Recent Literature – Summary (continued)

Turner et al. 1998	Empirical	Case	1 case	Evaluation of features for a collaborative notebook in virtual workplaces. Takes into account patterns of work and information flow. Adoption of notebook was slow. Individuals perceive their patterns of work differently than what they really are.
Fritz et al. 1998	Empirical	Questionnaire	230 employees in 9 firms with ongoing telecommuting programs	Examined influence of job characteristics, IT support and coordination methods on communication satisfaction for telecommuters and traditional office workers. Found task predictability positively influenced satisfaction for telecommuters. Support for and use of IT positively influenced satisfaction for both groups.
Wiesenfeld et al. 1999	Empirical	Survey	325 employees, sales team in large international company	Mediating effect of virtual status (# of days in office) on relationship between communication mode and organizational identification. Found that e-mail communication is critical for those out of the office often, to create and sustain organizational identification. Phone communication more important for those not out of the office as often. FTF was not strongly related.

After we collected the relevant papers based on the above criteria, we summarized the key elements found in each paper. Table 1 presents this summary. Using the information in the table, we identified the key issues discussed in the literature, and organized the papers and our discussion around these issues.

Findings from Literature Review

The review of recent literature (1998 to 2001) revealed 41 empirical and/or theoretically grounded studies that fit the above criteria. Six were literature reviews and 35 were empirical studies. Overall, these 41 articles address the following questions:

- Who are the virtual workers?
- How is communication influenced by virtual work?
- What technologies are used and how do they influence virtual work outcomes?
- What is the nature of the work-family conflict in virtual work?
- What are the outcomes of virtual work environments?
- What happens in virtual group work?
- What are key issues in the management of remote workers?

Who are the Virtual Workers?

There are two types of studies that discuss who virtual workers are. The first type is descriptive, usually presenting demographics and other characteristics of virtual workers based on general surveys or public records. Examples include a survey of telework in Ireland (Adam, 2001) and a study of telework in an organization (Johnson, 2001). There were a large number of such studies prior to 1998. The second type of studies investigates characteristics of telecommuters. These studies include factors leading to adoption/diffusion of teleworking (Harrington & Ruppel, 1999, 2001; Kavan & Saunders, 1998; Ruppel & Howard, 1998a, 1998b), the relationships between demographics and aspects of telework (Bélanger, 1999; Knight & Westbork, 1999; Scott & Timmerman, 1999) or individual factors affecting telecommuting success (Reinsch, 1999). Again, similar studies were conducted prior to 1998.

How is Communication Influenced by Virtual Work?

The area of communication has been the most researched in recent years. The published work comprises studies of communication patterns and studies of choices of communication modes. Research on communication patterns of virtual workers focuses on variables that may affect how virtual workers communicate with one another. In a study of the emergent organizational structure of a virtual group of researchers, graduate students and staff at universities and corporations working together to develop an artificial intelligence system architecture, findings indicate that, contrary to widespread predictions of decentralization and flatness in organizational structure, there were hierarchical tendencies in the group. These tendencies were more pronounced for more routine tasks (Ahuja & Carley, 1999). Bélanger (1999b) studied communication patterns of co-workers where some worked at the office and others did not. Job type influenced who telecommuters communicated with most, but telecommuters and non-telecommuters did not differ on whom they communicated with, suggesting that telecommuters were not left out of the office network. This result is similar to that of another study where teleworkers did not differ on their frequency of communication with managers, subordinates, co-workers and clients (Duxbury & Neufeld, 1999). Fritz et al. (1998) also found that the support for, and use of, information technology positively impacts satisfaction with communication for both telecommuters and non-telecommuters. However, task predictability influenced satisfaction only for telecommuters.

The second type of communication studies focused on choice of communication mode. One study found that high virtual status employees (those out of the office most often) found e-mail more useful in developing organizational identification than low virtual status employees who relied more on the telephone for communication (Wiesenfeld et al., 1999). Another study looking at knowledge sharing between geographically distributed sites of a Fortune 100 company revealed that technology is not well-suited to solve complex problems, and face-to-face communication is needed to disseminate best practices (Goodman & Darr, 1998). Personal relationships complement electronic coordination mechanisms in the performance of production steps outside a firm's boundaries in a supply chain (Kraut et al., 1999). E-mail is the most-used communication mode by teleworkers. However, employees with complex, interdependent networks, who deal with more political information, tend to rely more on the telephone for communicating (Dimitrova & Salaff, 1998). The use of electronic mail in telework and virtual teams was studied extensively in pre-1998 literature.

What Technologies are Used and How do they Influence Virtual Work Outcomes?

Prior to 1998, few studies investigated the use of technologies in virtual work (an exception is Gupta et al., 1995). Recent studies of technologies for communication in virtual work include computer-mediated communication systems (Hightower et al., 1998) and a collaborative notebook for virtual workplaces (Turner et al., 1998). Palmer (1998) found virtual organizations used the Web more than regular organizations, but made lower use of groupware, EDI and e-mail. Bélanger et al. (2001) found that the availability of information systems and communication technologies significantly positively affected productivity, performance and satisfaction of telecommuters, while high levels of required work group communication negatively affected perceived productivity and performance. Another study revealed communication technology is used less over time after a virtual team has been established, but tends to be used more when a collective understanding is required (Majchrzak et al., 2000). It is clear that many more questions need to be answered, such as what other technologies are effective at supporting virtual workers.

What is the Nature of the Work-Family Conflict in Virtual Work?

Duxbury and colleagues published a number of studies on the potential conflicts between family and work roles of teleworkers. One of these is included in the literature review in Table 1 (Duxbury et al., 1998), but several other studies have been published prior to 1998, or in non-IS mainstream journals. Others have also looked at aspects of the work-family conflict issue (Dixon & Webster, 1998; Donaldson & Weiss, 1998).

What are the Outcomes of Virtual Work Environments?

Most hypotheses-driven studies used outcomes of virtual work, such as productivity, satisfaction, or level of communication, as dependent measures. Potential outcomes were also discussed extensively in pre-1998 literature. For teleworkers, these outcomes include feelings of isolation, less commute time, more personal control, more or less job satisfaction, more or less work-family conflicts, more productivity and many more. For organizations, typical outcomes include savings on office space, increased efficiency, lower turnover or higher employee morale. McCloskey (2001) found that telecommuters reported more autonomy, less time-based work-family conflict, and received less career support than non-telecommuters. Another study of the effects of the work environment on turnover intentions, role stressors, job satisfaction and organizational commitment revealed that telecommuters had less role conflict, exhibited higher job satisfaction and were more committed to the organization (Igbaria & Guimaraes, 1999).

What Happens in Virtual Group Work?

Studies of virtual groups include those investigating the existence and development of trust in student teams who never met in a face-to-face setting (Jarvenpaa & Leidner, 1999; Jarvenpaa et al., 1998), the development processes for student teams (Knoll & Jarvenpaa, 1998) and perceptions of face-to-face vs. virtual groups of students based on gender (Lind, 1999). As these were student teams, it is unclear whether their findings are generalizable to the workplace, but they provide insight for managers implementing temporary teams of geographically dispersed, culturally diverse individuals. Maznevski and Chudoba (2000) intensively studied three teams whose members were globally distributed, with most members based in one firm, but some based in partner companies. Findings indicate face-to-face meetings were sometimes essential to effective performance, and these meetings and other communication modes were most effective when held on a regular basis.

What are Key Issues in the Management of Remote Workers?

Staples et al. (1999) investigated the management of remote employees in one organization. They found training, work experience and IT support were important factors influencing success. More recently, Staples (2001) used focus groups in several organizations with follow-up surveys to identify key issues in the management of remote workers. Results suggested communication, performance management, coaching, information technology and isolation are the main management issues.

Literature Prior to 1998

At least six pre-1998 literature reviews were published between 1998 and 2001 (Bélanger & Collins, 1998; Boudreau et al., 1998; Cascio, 2000; Grabowski & Roberts, 1998; McCloskey & Igbaria, 1998; Pinsonneault & Boisvert, 2001). Most of these reviews agreed that earlier studies lacked proper definitions of the terms used. The meta analyses also revealed a lack of theoretical foundations and hypothesis-driven empirical research, although more recent studies tended to be hypothesis-driven. Studies investigated beliefs/perceptions about telecommuting, level of usage, evaluations of work attitudes/outcomes and discussions/evaluations of work-family issues, or were pilot studies. In addition, earlier studies were limited because of weak methods such as small/poor samples and lacking control of extraneous variables. Two literature reviews (Boudreau et al., 1998; Grabowski & Roberts, 1998) focused mainly on virtual organizations, while the other four focused on virtual work.

The early literature, which was primarily prescriptive, most often discussed practical issues associated with setting up telecommuting programs. Some articles warned of the risk of exploitation as individuals with lower bargaining power were forced to work at home (DeSanctis, 1984), and of issues of work-family conflicts for telecommuters (Duxbury et al., 1992). A number of management challenges were identified in the early exploratory studies (Fritz et al., 1995), such as requirements for changes in job design (Mehlmann, 1988; Olson & Primps, 1984) and increased workload for managers (Ramsower, 1985). Personal characteristics, such as time management (Katz, 1987), and interpersonal skills, such as development of trust between manager and subordinate (Olson & Primps, 1984), were found to be critical to the success of telecommuters. Other studies addressed the use or design of technology in the distributed environment with respect to other aspects of the work environment (e.g., task type, coordination activities) (Gupta et al., 1995).

Summary

Our literature review shows that a number of barriers, enablers and outcomes of virtual work have been studied. In recent years, communication patterns and communication mode choice have been the most popular research areas in virtual work. Most of the studies on virtual work have been conducted using field studies in different virtual environments. The samples have often been limited, e.g., one organization, which can limit the generalizability of the findings, although sample sizes seem to be increasing in recent years. Given the complexity of organizations, the current research seems to be narrowly focused.

CASE NARRATIVES

In order to investigate whether a gap exists between research and practice, we present the following case narratives describing distributed work in two organizations. These distributed work situations represent two different, but very common, work situations found in companies today. Data was gathered for the cases from interviews with a senior manager and a front-line employee from work groups in each of the two companies. The information was recorded and then reviewed by a second researcher. Discussions led to the identification of several recurring themes, used to describe the cases. In addition, several important issues and questions raised by practitioners were logged, and are presented in our discussion section. The case descriptions were developed and analyzed collaboratively by the academicians and practitioners.

Case 1. Booz Allen Hamilton, Inc.

Booz Allen Hamilton (BAH), headquartered in McLean, Virginia, is a global management and technology consulting firm for industry and government. The firm has two major business units—the Worldwide Technology Business and the Worldwide Commercial Business—offering services in strategy, systems, operations and technology. The company has more than 8,000 full-time employees, with more than 4,000 professionals specializing in various Information Technology (IT) disciplines.

Distributed Teams

Within its Worldwide Technology Business (WTB) group, the IT practice is geographically dispersed in many offices across several states. For example, the Advanced Distributed Learning (ADL) delivery team within the IT practice has personnel in McLean, Virginia; San Antonio, Texas; and Eatontown, New Jersey. Using matrix management, distributed teams are formed with members who have the best skills for the project being undertaken. Teams form around skill sets and "capabilities," i.e., the ability to successfully deliver a high-quality, high-impact solution for the client.

The teams can be classified as *functional* teams, *delivery* teams, *development* teams and *external* teams. *Functional* teams bring together subject matter experts with the skill sets that match the client's needs and requirements, regardless of geographic location. When tasks require expertise outside of the functional team, members from other areas are matrixed into the functional team to form a combined *delivery* team. *Development* teams are brought together for proposal, marketing or other business development tasks such as client management (there is no immediate product delivery). These are cross-functional teams that include expertise and client experience from every business function. Finally, *external* teams are formed when BAH consultants work on a delivery with an external vendor/contractor.

As a result of the matrix organization, BAH consultants are very flexible and are accustomed to multiple affiliations within the firm. For example, one of the authors is the technical lead and project manager for some initiatives, a functional manager of a team of consultants assigned to multiple engagements and a participant in market development teams for different clients. These multiple affiliations with the firm require that consultants communicate frequently with many groups within the firm, with different clients and with vendors.

Technology

The firm has had great success using technology support for teaming. BAH provides each consultant with state-of-the-art tools for communicating and collaborating with team members, clients and vendors. Technologies available for use include project management, collaboration and knowledge management tools.

- **Project management tools.** Consultants have access to Webworks, which is a Web-based project management system. Webworks sites are created for each engagement, as well as for other internal initiatives. The site provides a virtual desktop offering consultants the ability to post news articles, conduct threaded discussions, assign or be notified of tasks, track progress of project tasks, post deliverables (documents, multimedia files, databases, etc.), create other sites, get contact information for other site users and e-mail them directly, and view, edit and create events in a shared calendar. Webworks is particularly useful when consultants are on the road or at home because they can easily access project-related information. Clients have access to the project site, and they can monitor progress, download deliverables and status reports, and participate in the threaded discussions. Webworks is also a very detailed record and documentation system since files, entries and actions taken by individual consultants are time stamped by the system.
- **Collaboration tools.** In addition to Webworks, BAH consultants use a variety of computer-mediated communication tools and technologies to support team and client collaboration. Videoconferencing facilities using a client-server system from PictureTalk, Inc. provide consultants with real-time and Web-friendly conferencing. Individual teams have video tele-conferencing (VTC) facilities, and individual consultants use desktop VTC equipment as required. The main office also has a state-of-the-art multimedia VTC auditorium and conference center for use by larger groups. Most consultants use a laptop as their workstation, and are able to access the BAH virtual private network (VPN) outside the office. They also use beepers and cell phones.

- **Knowledge management tools.** The firm has a knowledge management system called Knowledge OnLine, a Website that offers access to administrative support services, programs and information; directory services for BAH employees including online resumes; information on team capabilities and past performance; and information on requests for proposals from prospective clients.

Management Challenges

BAH's teams face many practical issues and concerns. These issues include breadth of multi-disciplinary domain, availability of collaboration tools and training.

- **Breadth of multi-disciplinary domains.** Identifying the right "mix" of team members with the requisite skill sets is a major management challenge. Senior managers use their own "rules of thumb" when making staffing decisions, considering factors such as type of contract; duration of the task; level of technical complexity of the problem/task; clients' backgrounds, preferences and environment; leadership structure within the team; and team member relationships. Many questions remain. For example, if a team needs 10 different skills, is it better to find three consultants who have multidisciplinary skills, or seven consultants who are more narrowly focused but deep in their expertise?
- **Availability and use of electronic collaboration tools.** While anecdotal evidence suggests that this makes a critical difference in team effectiveness, the relationship between availability and use is not clear. Managers also do not know whether and how the particular use of these tools make specific positive outcomes more likely. They also need to understand the impact of employees' level of expertise or attitude towards use of those tools on team effectiveness.
- **Training in virtual workplace tools.** Training in the use of advanced computer and collaboration tools is left up to each consultant. Online and Computer-Based Training courses are available for consultants to use on their own time. There is a need to study whether company-sponsored training or orientations make a difference in consultant effectiveness, and whether more formal training would be valuable. Another potential training area in BAH is interpersonal communication and skills for effective teaming. Are project managers effective because of interpersonal qualities, or the use of automated tools? Should teams be trained on project management in virtual teams? While distributed environments seem to require new skills, it is not clear to management how teams can be prepared to work most effectively in them.

Case 2. ABC Telco

ABC Telco (a fictitious name) is a Fortune 100 communications services company headquartered in the Southeast USA. ABC Telco's operating telephone company serves local residential and business customers in nine southern states. This narrative focuses on the management of network service technicians, who have front-line responsibility for the installation and repair of telephone services for customers in one district of ABC Telco, and the management challenges in this environment. There are about 700 technicians in this district. Frequently, the technicians are the only representatives of the company with whom the customer has direct interaction.

Virtual Workers: Network Service Technicians

Network service technician work is generated by a customer order for telecommunications service (new or repair) or an anticipated order. Each technician completes four to five work orders per day. Technicians are evaluated based on efficiency in completing orders and quality of the work performed. Orders that require multiple visits by technicians can negatively impact performance evaluation.

A supervisor is responsible for managing teams of technicians. Depending on the density of customers and service demand, supervisory team sizes can range from eight to 15 technicians. The supervisor is responsible for ensuring the quality of work completed by technicians, including visiting and inspecting the site where work was completed. Supervisory duties also include providing training for technicians both on a formal basis, such as making sure that changes in methods or techniques reach everyone, and on an informal basis, such as responding to individual questions which arise due to unique field conditions or changes in technology. In addition, the supervisor must conduct performance evaluations and counsel technicians on career development plans, in addition to other traditional supervisory duties. Finally, the supervisor must mentor and work closely with technicians who are new to the job.

Work orders are assigned by a centralized provisioning center where technicians report to work. However, priorities for orders may change depending on customer or field circumstances. The supervisor coordinates technician assignment for this type of order exception, and often must coordinate the response or respond directly to the customer. The supervisor may be located in the same building as the technician, as may other technicians. Work is performed at customer locations and at ABC Telco equipment facilities. At the end of the day, the technicians report back to the work center and are dismissed. There is limited or no interaction between technicians, their colleagues and their supervisor during the day unless specific plans are made for interaction. In addition to being geographically distributed, these teams are also distributed in time. Some teams are staffed in shifts 24 hours per day, seven days per week. Others have eight-hour days, but often work overtime.

Technology

Information and communication technologies are used extensively by the technicians and their supervisors. All supervisors and technicians have cellular telephones and pagers. Technicians are also equipped with one of the most advanced information and communication systems in the industry (TechNet). The system is used for assigning and completing telecommunications service orders, for data communication and to perform testing functions. These terminals are laptop computers with wireless communications capability. The first work order for the day is loaded on the terminal prior to the start of the workday. After a technician has completed all work on the assignment, the assignment status is updated in the system when the technician establishes connection to the mobile data network. The system performs automatic quality checks on the line to be sure the service is working properly. The work order is then released and a new order is assigned to the technician. The system allows orders to be dynamically assigned based on changing priorities during each business day. E-mail and broadcast communications capabilities exist in the system. However, it is only during the four or five times each day when a technician is connected that he or she has access to this feature.

Management Challenges

The extensive use of technology has enabled more efficient work practices for the technicians. However, management faces a number of challenges.

- **Coordinating work activities.** Management must insure that changes in procedures and equipment are incorporated into work processes, guidelines are followed and a consistent "face" is presented to the customer. While guidelines exist, work process changes are often necessary due to field conditions. Technicians use judgment in making decisions in the field and are encouraged to be creative. However, the need for workers to be independent and creative must be balanced with a need for consistency in processes. As a result, management is finding that the span of control must be smaller in distributed and dynamic work environments.
- **Measurement tools.** Supervisors are not able to observe the work being performed. The current information systems provide numbers (e.g., orders completed by worker, etc.). However, it is difficult for supervisors to provide accurate and useful feedback to technicians on the quality of their work. Managers feel that better decisions could be made if there was a system

providing them with qualitative measurement criteria for work performed in distributed environments.

- **Training.** Management is concerned with how to train in a timely and consistent manner. Staggered scheduling makes it difficult to address these training issues. Some technicians might receive information because they are at the work center while others are left out. New technicians receive extensive training, but actual field conditions vary significantly and many questions arise. If the supervisor cannot respond to these questions, the quality of work performed suffers, as does productivity and the technician's satisfaction with the job (at the extreme, resulting in expensive employee turnover).
- **Information sharing/team building.** Management is concerned that it is difficult for technicians to develop relationships with team members. Before most communication took place via technology, there were more meetings and more time was spent at the work centers, enabling information to be exchanged and relationships to develop naturally. Information that can increase productivity (e.g., sharing knowledge on troublesome parts of the network) is not shared easily in the current environment. This situation is especially true for newer people who do not have relationships and are not part of the "network" of more experienced technicians.

DISCUSSION

We examined two real-life virtual work environments, which represent common work situations. The teams of consultants represent a collaborative work environment with fluid teams whose membership varies according to client and project needs. The teams of technicians represent a less interdependent work environment where membership in the team is more stable. Obviously, the job functions of the team members in the two organizations, their organizational roles and responsibilities, and their training and backgrounds are very different. In addition, the two companies have different structures, cultures and competitive positioning. We next discuss a number of managerial themes and research questions which emerged from our interview data. The narratives were discussed from a managerial and organizational perspective, and not an IT functional perspective. There are additional important IT issues, e.g., the underlying IT architecture, security and access to information, which are not included.

Team Building

Lateral communication among team members is more complex in virtual work environments. Technicians at ABC Telco, who have little physical interaction with colleagues, sometimes have difficulty establishing relationships with them. Their organizational communication system is more task-focused than relationship-focused. By contrast, communication between and among consulting teams (including their clients) is a critical aspect of the consulting culture and operations at BAH. These relationships and processes are greatly facilitated by Web-based tools, as well as the computer-mediated communication support that is available to consultants. Therefore, some of the issues and questions that practitioners need answers to include: What factors are critical for building and maintaining a solid team culture and effective communications process in the distributed environment? What communication structures and mechanisms can be used to distribute information and coordinate tasks among team members in a timely manner?

Organizational/Management Structure

Hierarchical communication between employees and managers also becomes more complex in virtual work environments. In the ABC Telco example, coordination of unpredictable tasks, such as customer requests or changes, is difficult for supervisors. In addition, the appropriate span of control for management is not clearly specified in either company. At ABC Telco, the span of control may fluctuate depending on the system status or customer situation. At BAH, the span of control is intentionally unspecified because the company has a very complex, non-hierarchical, team-based structure that self-organizes around missions, tasks and priorities. Both the number of team members and the mix of skills needed are difficult for management to determine. The cases highlight some questions in need of answers for practitioners, such as: Does the role of management change in a distributed environment? What role, if any, does distance play in determining organizational structure and job design? How are resources best allocated in the distributed environment?

Information Sharing and Distribution

Communicating organizational information in a timely manner is a challenge, and information sharing among team members may be difficult. Technicians at ABC Telco often have useful information about specific field conditions. However, opportunities for sharing this information are limited given that technicians do not have a ready method to post system messages and alerts for their fellow workers. At BAH, the extent of information sharing and distribution may vary from practice to practice, but in general, there are a number of state-of-the-art tools for collaboration available. Despite the latest technologies and applications, the single best source of knowledge within the firm is an individual's interpersonal network developed from working with others on previous tasks, or meeting others at professional forums or training courses. Questions of interest to practitioners include: How can information sharing be facilitated in a distributed environment? How is time-sensitive information best distributed? What are effective interpersonal networking techniques used by the most successful consultants, or the most successful service technicians?

Employee Assessment/Development

Measurement and monitoring of employees' work is complex in the distributed environment. For the technicians, output measures are well documented and understood; however, individual work patterns are less clear. Better measurement criteria on work patterns or processes would enable management to more fairly assess and provide effective feedback to employees. These issues lead to interesting research questions, such as: What are the best methods and metrics for employee assessment in virtual work? What is the role and appropriateness of employee monitoring in this environment?

Development of employees for future assignments, including different roles and responsibilities, can be difficult. In particular, the development and training of new employees is difficult in the distributed environment. Further questions from practitioners that need investigation include: How are the critical management functions of employee development best performed in the distributed environment? In a distributed environment where team members do not see each other daily, are the factors considered as input to a team member's evaluation different than for employees who are co-located? Are some factors (e.g., writing ability for remote team members who communicate through e-mail) weighted more heavily than others?

Work Process Training

How does management ensure that employees are performing work activities most effectively? At ABC Telco, employees must perform work according to recommendations and guidelines. However, employees must also have the discretion to modify procedures based on field conditions. This tension between organizational consistency and employee independence is particularly complex in the distributed environment. In discussions with practitioners on these issues, some questions identified as needing further investigation include: What skills need to be developed for different types of virtual work environments? How can we train distributed workers for optimum job knowledge sharing and work in virtual teams? The complexity and rapid change of technologies adds to the challenge of providing training at a distance.

IT Training and Readiness

The use of information and communication technologies is critical to effective performance in the distributed environment. In both corporations, effective use of technology for communication, information gathering and sharing was a critical success factor. Examples of questions of interest in this area include: How is necessary IT training most effectively employed in the distributed work environment? At what stage are employees (and the organization) in their acceptance of, and readiness to use, information and communication tools?

Choice of Communication Technologies and Tools

In both organizations, choosing the best communication technology was critical, but management had little guidance in how to make the choice. At BAH, Web-based technologies and communication/collaboration technologies are the backbone of internal information systems. Tools such as Webworks and Knowledge Online allow consultants to work productively from any location. Typical questions of interest can include: How does management assess the appropriateness of available communication technologies and applications? What tools are available, and which are best to support collaborative work in distributed settings? How does management assess the effectiveness of these tools under various conditions?

Exploring the Gap

The previous sections presented information on existing research in virtual work and current practitioner issues as illustrated by two case narratives. Does the literature address questions of importance to managers? Does it enhance or provide insights into management practices in this rapidly evolving work environment? Table 2 presents the issues highlighted by the two narratives, and maps existing literature to these issues in order to identify the gap between research and practice on virtual work.

Table 2 provides a high-level view of potential gaps between research and practice on virtual work. In general, it seems that the literature does not always adequately capture the complexity of virtual work environments, creating a gap between actual managerial concerns and academic research. While several of the topics of interest to practitioners are addressed, they are not addressed in as much depth as what seems useful to or needed by practitioners. For example, researchers often look at coordination and communication in general. Yet, practitioners are interested in, not communication in general, but how communication within virtual work can be better used for information sharing, information distribution, perfor-

Table 2: The Gap and Overlap in Virtual Work Research and Practice

Practitioner Issues	Examples of questions of interest	Overlap*	Examples of questions/areas researched	Research in Virtual Work
Team building	What factors are critical for building and maintaining a solid team culture and effective communications process in the distributed environment?		What is the effect of virtual work on communication patterns and structures in teams and work groups?	How is communication influenced by virtual work?
	What communication structures and mechanisms can be used to distribute information and coordinate tasks among team members in timely manner?		What effects does telework have on group communication structures?	How is communication influenced by virtual work?
Organizational/ management structure	Does management role change in a distributed environment?		What factors lead to more successful management of remote workers?	What are key issues in the management of remote workers?
	What role does distance play in determining organizational structure and job design?			
	How are resources best allocated in the distributed environment?			
Information sharing and distribution	How can information sharing be facilitated in the distributed environment?		How is communication and coordination performed in virtual work?	How is communication influenced by virtual work?
	How is time-sensitive information best distributed?			
	What are effective interpersonal networking techniques used by most successful consultants, or most successful service technicians?		How is communication in teams affected by virtual work?	How is communication influenced by virtual work?
Employee assessment and development	What are the best methods and metrics for employee assessment in virtual work?		Are demographics of teleworkers linked to success or other outcomes?	Who are the virtual workers?
	What is the role and appropriateness of employee monitoring in this environment?			
	How are the critical management functions of employee development best performed in the distributed environment?			
	In distributed work teams that do not see each other daily, are there differences between the factors considered in team members' evaluations and those of co-located teams?		How can trust be developed between distributed team members?	What happens in virtual group work?
	Should some performance evaluation factors be weighted more heavily than others in virtual work? Which?			
Work process training	What skills need to be developed for different types of virtual work environments?		What are the characteristics of individuals performing virtual work, including skills?	Who are the virtual workers?
	How can we train distributed workers for optimum job knowledge sharing and work in virtual teams?			
IT training and readiness	What IT training is needed and how is it most effectively employed in the distributed work environment?			
	At what stage are employees (and org.) in their acceptance of and readiness to use information and communication tools?			
Communication tools and technology choice	How does management assess the appropriateness of available communication technologies and applications?		Which communication tools lead to greater success in telework?	What technologies are used and how do they influence virtual work outcomes?
	What tools are available, and which are best to support collaborative work in distributed settings?		Which communications tools are available and used in virtual work?	What technologies are used and how do they influence outcomes?
	How does management assess the effectiveness of collaborative tools, where they are successful, and under what conditions?			
				What is the nature of the work-family conflict in virtual work?
				What are the outcomes of virtual work?

* A darker cell means more overlap. A white cell indicates limited or no overlap.

mance feedback and/or relationship development. Another example is the importance of time-sensitive information to managers, while researchers rarely classify information more precisely than formal/informal or personal/work-related (although there are exceptions).

There are some areas of research that managers seem to show little interest in. For example, work-family conflicts have led to numerous studies of how virtual work and telework affect the balance between work and family life. Yet, practitioners do not seem to view this area as a major concern. However, we believe that this might be a justifiable gap because there is a need for some researchers to address longer-term issues about societal effects of virtual work on individuals, organizations and society. For example, research on work-family conflicts or the effects of remote work on pollution levels is needed, but is of little direct or immediate interest to most managers. Another area where researchers seem interested in different questions than practitioners is the characteristics of teleworkers. Practitioners are interested in employee assessment and evaluation in virtual work. Researchers seemed more interested in individual characteristics that can predict who will be successful teleworkers.

One area that receives interest from both sides is team building. Researchers are investigating issues of trust and communication in virtual teams, issues that practitioners face and want answers to. Practitioners, however, seem to want more precise answers, for example, including team culture and time sensitiveness to the distributed team work performed. Another area of overlap is the evaluation of tools and technologies for distributed and virtual work. Researchers have often focused on e-mail and the Web as communication tools. These communication technologies are important, but managers are also interested in groupware and knowledge management tools for virtual work. In looking at technologies in future virtual work studies, researchers will have to be more precise about the work processes these technologies can be used for, such as the best tools for information distribution, knowledge sharing or relationship development.

A few areas of concern for practitioners in virtual work seem not to be addressed by IS research. One is employee assessment and development. Human resources literature addresses some of these issues, but IS researchers should incorporate this knowledge and investigate these issues as well from their own perspective. In particular, IS researchers should study employee assessment and development issues in virtual work, as these often require the development and use of technology applications. For example, computer monitoring of remote workers can lead to ethical questions. Future research could focus on evaluating the appropriateness of various technologies for employee feedback and assessment. Finally, another surprising gap between research and practice is in the area of IT training and readiness. It seems that this area is well within the core of the IS discipline and yet, training for virtual workers is rarely addressed (empirically) in current research.

Why is there a gap, small or large, between research on virtual work and issues and concerns of practitioners in this area? Clearly, there is a need to have better communication between practitioners and researchers as to issues of importance to each, and on how they can benefit from one another's work. In exploring the gap, several factors become apparent which may have a role in creating part of this gap, for example, the multidisciplinary nature of the topic, the time-intensive research methodologies required to perform relevant field research and the lack of proper definition of the unit of analysis.

Multidisciplinary Nature

The problems faced by managers are multidisciplinary in nature. Conversely, in the academic world, virtual work research is fragmented by areas. Business organizations require a more systemic and holistic approach to studying virtual work. For example, one cannot separate the technology issues from the organizational communication issues in virtual work. Personnel management issues, such as training, development and career path management, become more complex with distributed work. An understanding of interpersonal relations and group behavior from a social psychology perspective is critical to understanding how relationships are formed and maintained in an environment where cooperating individuals are working in different contexts with different technologies. Another example of the multidisciplinary nature of these issues is the need for organizations that want to effectively implement distributed work arrangements to redesign their physical workspace.

Time-Intensive Research Methodologies

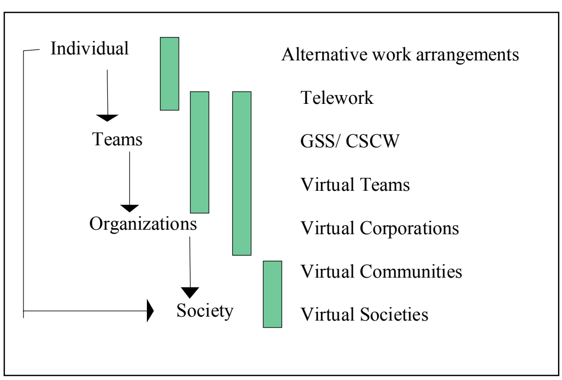
One potential factor that exacerbates the gap between practice and research is the difficulty of conducting relevant field research. Longitudinal case studies or multiple case studies are the most appropriate research methodologies to study virtual work. The issues highlighted by the case narratives are difficult to investigate in laboratory settings with students. The rigor of the lab removes so many relevant factors that it trivializes the research questions. The type of research needed for virtual work requires substantial time investments from the researchers' perspective. It is therefore more difficult to accomplish this research and get the appropriate rewards of timely publications.

Unit of Analysis

One of the important concepts to be considered in all research is the unit of analysis. The unit of analysis should be appropriate to the research question, and the research question should be relevant to the "unit" being studied (i.e., if you are doing a study of alternative work arrangements and you are surveying individuals, hopefully the research questions (and answers) are interesting, thought provoking and useful to these individuals). Figure 1 presents a proposed view of the appropriate unit of analysis in virtual work research adapted from Agres et al. (1998). The organizational level unit of analysis could include studies of telecommuting, GSS/CSCW, virtual teams or virtual corporations, for example. This unit of analysis may also be easier to focus on because there are a large number of metrics that can be used to assess organizational changes (e.g., ROI, revenue, customer satisfaction, service levels).

There might be other explanations for the existence of the gap. The important point though is that practitioners are faced with issues and challenges when being involved in or managing virtual work environments. As academics, we should consider these as opportunities to perform research of importance to both the academic field and practitioners. There is always a minimum gap that is unavoidable, and it is rightfully appropriate for such a gap to exist. For example, research may try to address issues that managers do not find immediately useful or relevant, as researchers may take a broader and longer-term view of some aspects of virtual work. However, some "inappropriate" gaps exist as well. These are the gaps where practitioner issues that are also core to information systems and technology researchers are not being addressed, such as IT training and readiness. Finally, we only looked at two case narratives. While other practitioner issues might have been discovered in looking at additional companies, we believe the narratives provide the reader sufficient insight into practitioner issues in virtual work.

Figure 1: Proposed Units of Analysis in Virtual Work



CONCLUSION

It is an exciting time to be involved with research on virtual work. The capabilities of technologies change at an ever-increasing rate, but the core issues that must be addressed for individuals, organizations and society to function in this virtual setting will remain for years ahead. Through an in-depth review of virtual work literature and insights from two case narratives, we found that a gap exists between academic research and managerial concerns. In general, it seems that the literature does not always adequately capture the complexity of virtual work environments. In particular, we identified gaps in the areas of team building, organizational and management structure, information sharing and distribution, employee assessment and development, work process training, IT training and readiness, and in the choice of communication technologies and tools. We discussed potential reasons for this gap, such as the multidisciplinary nature of managerial concerns, the requirements for time-intensive research methodologies and some confusions in the units of analysis used in research.

ENDNOTES

1. This paper was originally published in *Information Resources Management Journal*, 15:3, July-Sept., 48-70.
2. *Information Systems Research, MIS Quarterly, Journal of Management Information Systems, Information and Management, Information Resources Management Journal, IEEE Transactions Journals, The Journal of End User Computing, The Information Society, and Database.*

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Chapter II

The Societal Impact of the World Wide Web — Key Challenges for the 21st Century

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ABSTRACT

This paper addresses the impact of information technology (IT) and the World Wide Web (WWW) on the 21st century and the challenges which we will face as responsible members of a dynamically changing society. Reviewing the spread of potentially alienating technology, the paper highlights the implications for change with reference to the "haves" and the "have nots" — developing societies, economically disadvantaged groups, women and children. The authors argue that organisational, sociological and cultural factors may inhibit an effective transformation to a global Information Society. Particular consideration is given to policies, infrastructure, human resources and development responsibilities in developing societies.

INTRODUCTION

Many lessons from history offer strong evidence that technology can have a definite effect on the social and political aspects of human life. At times it is difficult to grasp how supposedly neutral technology might lead to social upheavals, mass migrations of people, and shifts in wealth and power. Yet a quick retrospective look at the last few centuries finds that various technologies have done just that, challenging the notion of the neutrality of technology. Some examples include the printing press, railways, and the telephone.

The effects of these technologies usually begin in our minds by changing the way we view time and space. Railways made the world seem smaller by enabling us to send goods, people, and information to many parts of the world in a fraction of the time it took before. Telephones changed the way we think about both time and distance, enabling us to stay connected without needing to be physically displaced. While new technologies create new opportunities for certain individuals or groups to gain wealth, there are other economic implications with a wider ranging impact, political and social. Eventually, as the technology matures, social upheavals, mass migrations, and shifts in economic and political power can be observed. We find concrete examples of this dynamic phenomenon during the Reformation, the industrial revolution, and more recently, as we witness the on-going information technology revolution.

Before the Reformation, the church controlled an effective monopoly on knowledge and education. The introduction of the printing press in Western Europe in the mid-15th century made knowledge and ideas in book form widely available to a great many more people. Printing hastened the Reformation, and the Reformation spread printing further. By the early 16th century, when Martin Luther posted his 95 theses on the castle church, the political movement was well underway. The printing press changed the way in which we collected, transmitted, and preserved information prior to that time. Mass production and dissemination of new ideas, and more rapid response from others were instrumental in launching a worldwide social phenomenon.

Dramatic changes in the economic and social structures in the 18th century characterized the industrial revolution. Technological innovations were made in transportation and communication with the development of the steam engine, steam shipping, and the telegraph. These inventions and technological innovations were integral in creating the factory system and large-scale machine production. Owners of factories were the new wealthy. The laboring population, formerly employed predominantly in agriculture, moved in mass to the factory urban centers. This led to social changes as women and children were introduced into the workforce.

Factory labor separated work from the home and there was a decline of skilled crafts as work became more specialized along the assembly line.

The inventions of the telegraph and telephone dramatically changed the manner in which we conduct business and live our daily lives. They allowed the collection, validation, and dissemination of information in a timely and financially efficient manner. More recently, we are experiencing the information technology revolution, led by the introduction of computers. The rate of change has accelerated from previous times—with generations of technology passing us by in matters of months rather than decades. We are witnessing significant shifts in wealth and power before our eyes. Small start-up high technology and Internet companies, and their young owners, represent a very wealthy class—and an extremely powerful one. Small countries such as Singapore and Ireland, through the strategic use of information technology and aggressive national policy, have transformed their respective economies and positioned themselves in the competitive global economy.

The Internet, a complex network of networks, is frequently spoken of as a tool for countries to do likewise. The Internet removes the geographical and time limitations of operating in a global economy. The banking industry has been revolutionized with Internet banks who can collect, validate, and disseminate information and services to any people group—internal to the organization and external to its customers—in a timely and financially efficient manner. Similar scenarios exist in the worlds of retail, healthcare, and transportation.

There is an underlying assumption in the popular belief that the Internet may be the savior to the developing countries of the world. Such thinking is dependent on a single premise: the belief that access to information gives access to the global marketplace which in turn leads to economic growth. Information is power; knowledge is wealth. The vehicle for access is information technology and communications infrastructure (ITC). Mohammad Nasim, the minister for post and telecommunications in Bangladesh, one of the poorest countries in the world, restated the premise, saying "We know full well how important a role telecommunications play in a country's economic development" (Zaman, 1999). The converse is also true. Lack of IT access leads to an increased inability to compete in the global market place which leads to further economic poverty. What we are witnessing is therefore either an upward or downward spiral phenomenon. This raises some interesting and important questions for society, such as: What is the current information access through the Internet? Who are the "haves" and the "have-nots" of information access? How can the Internet address the societal challenges?

This paper attempts to address these questions and related issues. In the first section we document the current state of information technology diffusion and connectivity, and related factors such as GDP, population density, and cultural attitudes. The second section examines more fully the question of who comprises the "haves" and the "have-nots" so frequently mentioned. Across and within country comparisons are made, noting in particular disadvantaged groups, urban vs. rural communities, and women and children as groups that are frequently forgotten, but who are vital to true transformation to a global information society. The third section offers some concrete suggestions as to how the Internet may be used to address the growing gap between those who have and those who don't. We report some country examples which illustrate both the progress and the magnitude of the challenge as societies, governments, and other key change agents attempt to redress the problem. Finally, we make two observations. One is that for those who don't have, there is little demand *to have*, as well. This is in large part explained by the second observation, which is that a multi-level complex challenge must be overcome in order to leverage technology-based services, such as offered by the Internet, as a sociological tool to reduce economic disparity. We challenge the reader to look inward for each one's individual responsibility in this big picture.

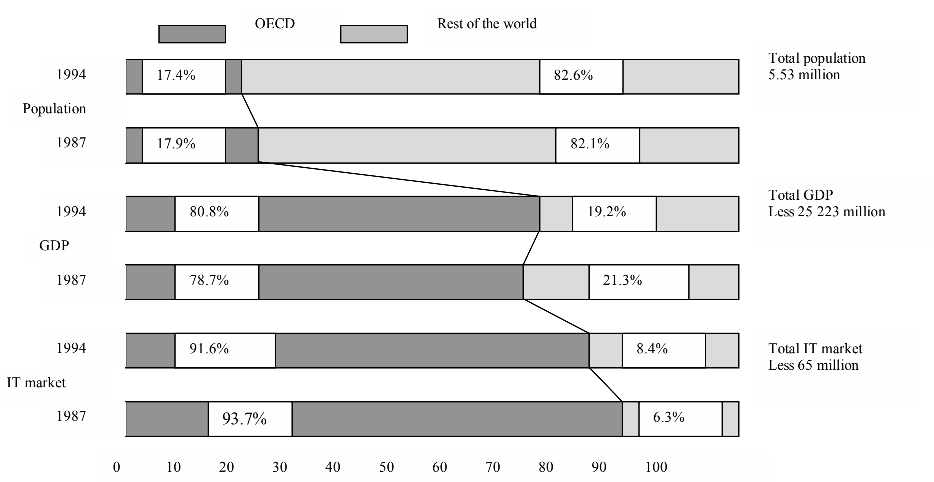
INFORMATION TECHNOLOGY ACCESS

In 1995, the world IT market as measured by the revenue of primary vendors was worth an estimated US$527.9 billion. Between 1987 and 1994, its growth rate averaged nearly twice that of GDP worldwide. It was particularly high in Asia climbing from 17.5% to 20.9% of world share during that time. Nevertheless this strong growth did little to redress the geographical imbalance in the world IT market — *markets outside Asia and the OECD area (ROW) accounted for only 4% of the world total*.

From a world population of 5.53 billion, *ROW accounts for 82.6%* of the total population yet from a world GDP of US$25,223 billion, *ROW accounts for only 19.2%* (decreasing >2% over the last seven years) and from a total IT market of US$455 billion, *ROW accounts for only 8.4%* . See Figure 1.

The IT market has remained concentrated within the G7 countries at around 88%, with the United States accounting for 46% of the market. In terms of installed PC base the US was by far the world leader with 86.3 million units, well ahead of Japan (19.1m), Germany (13.5m) and the UK (10.9m). In the US this averages at 32.8 PCs per 100 inhabitants. The Internet now reaches into every part of the globe with the number of host computers connected to the Internet increasing from 3.2 million in July 1994 to 6.6 million in July 1995, 12.9 million in 1996, 16.1 million by January 1997 and 29.7 million by January 1998 (Network Wizards). This is more than a tenfold increase since July 1993 as shown in Figure 2.

Figure 1: Share of OECD Member Countries in World Population, GDP and IT Market 1987-1994

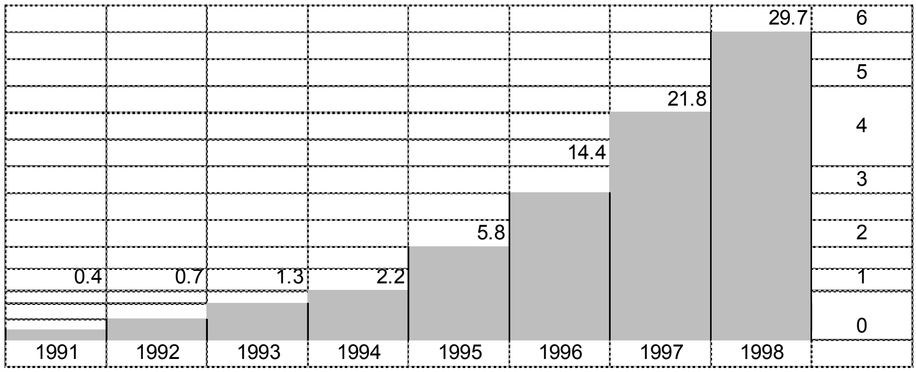


Recent estimates indicate that some 90 countries, just under five million machines and some 100 million users worldwide are connected to the Internet (NUA Internets Survey, 1998). However, Internet hosts per one million inhabitants by country income show huge differences between the rich and the poor, with 31,046 hosts for the highest income countries and only nine per million inhabitants in the poorest. The level of LAN implementation differs significantly across countries, with the US accounting for 55%, Western Europe 32% and *ROW only 13%* of the installed base of LAN servers .

This has to be examined at two levels: the rates of PC diffusion and connectivity. In terms of the number of corporate PCs per 100 white-collar workers, leading countries such as Norway, Switzerland and the US have more than 100, major Western European countries 60-80 and Japan only 24 (see Figure 3). As for PCs connected to LANs, 64% of corporate PCs are on a network in the US but only 21% in Japan (Dataquest, 1995). Corporate cultures in Asia may be less conducive to on-line management.

Access to telephone service is a good indicator of the state of a country's telecommunications infrastructure as this plays a large role in accessibility to information. More than 90% households in high income countries have a telephone line (and some have more than one), whereas only 2% of households in low income countries are similarly served. Of 950 million households in the world, 65% of the total do not have a telephone. Figure 4 shows the distribution of telecommunications against wealth.

Figure 2: Internet Host Computers (Millions)



The technology gap is strikingly apparent in telephone usage, where consumers in the United States make an average of 2,170 calls per inhabitant annually, which converts into just under seven calls a day. Only Canada and Singapore come close to the American average; Canada because of the similarity of culture and technological deployment, and Singapore by virtue of the heavy concentration of business within the small city-state. The United States' use of the telephone remains approximately three times higher than the European, Japanese and Australian averages, which seem to be clustered at between the 600-800 call per inhabitant level.

The difference between the United States and the Latin American and some of the Asian countries is even more striking. The average American makes 10 times

Figure 3: Number of PCs Per 100 White Collar Workers

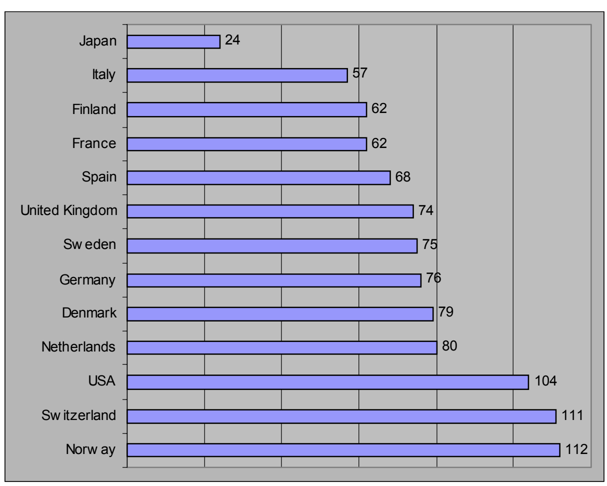
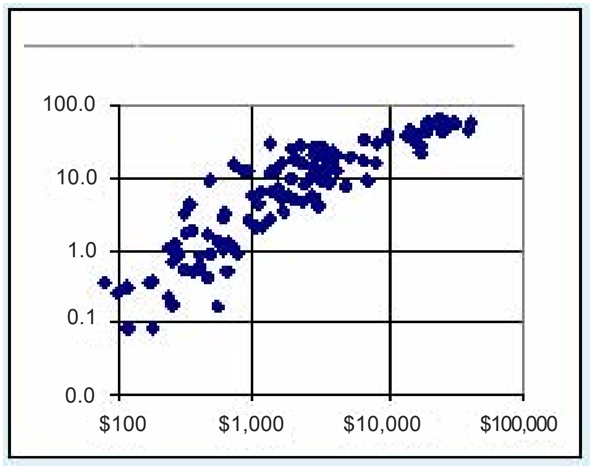


Figure 4: Lines Per 100 Inhabitants in Relation to GDP



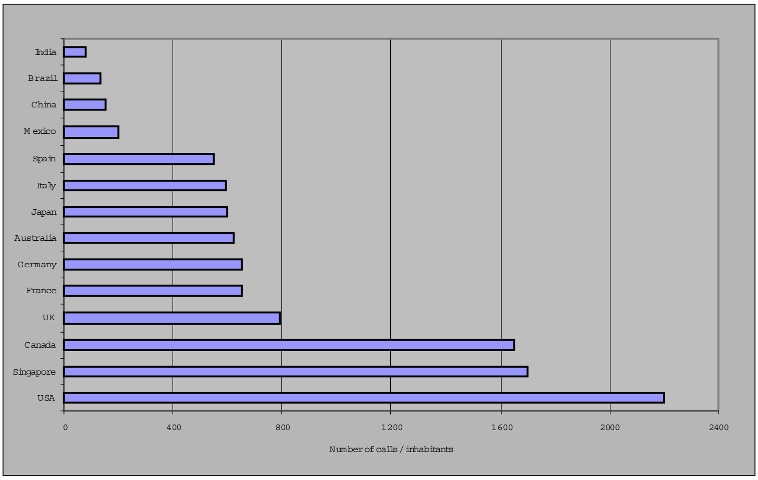
as many calls as the average Mexican, 20 times as many calls as the average Chinese, and 40 times as many as the average Indian. As the developing countries make greater inroads into extending their networks and their inhabitants succeed in integrating the telephone more into their daily lives, it is to be expected that their telephone usage will eventually start to catch up to that of the more developed countries but it will undoubtedly take some time to do so.

While the technology invasion has offered developing countries amazing opportunities to leapfrog over stages of growth in their programs for industrialisation and advancement, the drive for information can often occur only at the expense of other basic infrastructure needs which are regarded as norms for advanced societies. Illustrative of these trade-offs are countries who are currently making major investments into their ITC infrastructure, as shown in Table 1. China aims to enter the 21st century as an information economy yet has an average GDP which is only 1/50th of the US; Argentina has a school life expectancy of less than 4 years compared to over 16 in Australia, and India boasts a female adult illiteracy problem of 62.3%. The statistics are even more alarming when comparisons are made with rural communities, where only 7% of the rural population in China and 2% in Argentina have access to sanitation.

The Haves and the Have-Nots

The haves and have-nots are generally differentiated based on a variety of factors such as income and education levels. We generally think of the haves and the have-nots from the perspective of the international arena, dividing countries into

Figure 5: Number of Calls Per Capita by Country

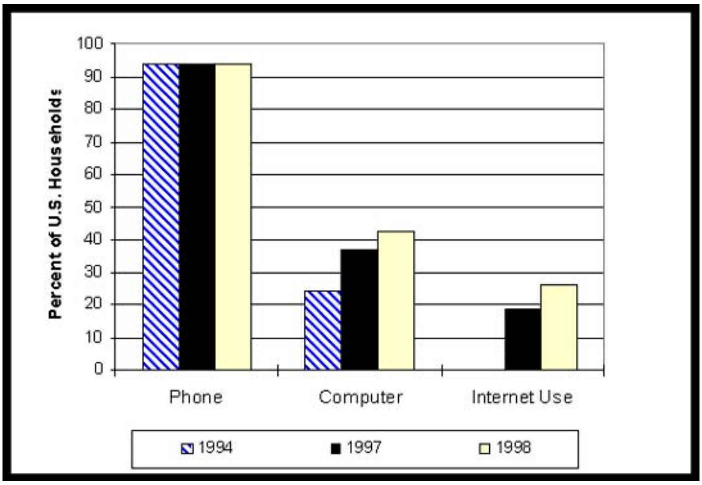


two large categories: developed and developing, with the greater proportion of countries considered developing. There is a tight coupling between the ITC infrastructure of a country and its income status. It comes as little surprise then that despite rapid growth of the Internet, some 97% of users are in high-income countries which account for just 15% of the world's population (Tarjanne, 1996). The US boasts four out of 10 homes owning a personal computer and one in three of these has a modem enabling the computer and telephone to be connected (see Figure 6). By the year 2000 at least half of all US homes will have two or more telecommunications lines. At present the median age of users is 32 years and dropping, 64% have college degrees and 25% have an annual income higher than $80,000. Half of Internet users have managerial or professional jobs and 31% are women. There are now more than a million Web sites for them to visit.

Table 1: Worldwide Indicators

	1995 US$ gdp pc	School life expectancy	Adult (F) illiteracy	Economic Rural Activity %	% access to sanitation
USA	26037	15.8	3.1	59.9	*
Japan	41718	14.8	*	50.0	*
UK	18913	16.3	*	52.8	*
Australia	20046	16.2	*	48.1	*
China	582	*	27.3	72.9	7
India	365	*	62.3	*	14
Philippines	1093	11.0	5.7	49.0	67
Argentina	8055	3.8	3.8	41.3	2
Vietnam	270	*	8.8	74.1	15

Figure 6: Percent of U.S. Households with a Telephone, Computer and Internet Use



It is also useful to examine the question of the haves and have-nots from a second vantage point—a within country perspective. In fact, while the majority of the population within a developed country may qualify as "have," there is a subset of the population which does not meet the criteria. For example, the United States is considered a developed country, but the poorest 20% of households receive a smaller share of income than in almost any other developed country. Over six million homes did not have phone service in 1997 (ITU, 1998). By regions, households in Oceania (predominantly Australia and New Zealand) are the most wired with penetration rates of over 90%. This is in contrast to Asia, where about 20% of households have a telephone, and to Africa, where the figure drops to 6% (ITU, 1998). Within country comparison by urban and rural areas also shows marked differences. Over 80% of Thailand's population still lives in rural areas, yet less than 40% of telephone lines in the country are in non-urban areas. These within country variances at best retard the overall economic growth of the respective countries.

Whether developed or developing, we also observe significant segments of the population that do not have access to the ITC infrastructure. These groups are characterized by low income, young limited education, member of a minority group, elderly, handicapped, and rural. The irony is that it is these groups that, were they to have access, they would be simultaneously empowered to take steps to improve their economic well-being. It is these groups that receive huge benefits from being able to engage in job search activities, take educational classes, or access government reports on-line for example.

Falling Through the Net: Defining the Digital Divide

A 1999 survey of the digital divide in the U.S. (third in a series from 1995) shows that while there is expanded information access, there is a persisting "digital divide" which has actually increased since the first survey (see Figures 7 and 8). The least connected are typically lower income groups, and Blacks and Hispanics. Additional geographical locations (urban city centre and rural), age, education and household type are additional factors leading to disadvantaged groups. The following are profiles of groups that are among the "least connected," according to the 1999 data:

- **Rural Poor**–Those living in rural areas at the lowest income levels are among the least connected. Rural households earning less than $5,000 per year have the lowest telephone penetration rates (74.4%), followed by central cities (75.2%) and urban areas (76.8%). In 1994, by contrast central city poor were the least connected. Rural households earning between $5,000-$10,000 have the lowest PC-ownership rates (7.9%) and online access rates (2.3%), followed by urban areas (10.5%, 4.4%) and central cities (11%, 4.6%).

  A high-income household in an urban area is more than *twenty times* as likely as a rural, low-income household to have Internet access.
- **Rural and Central City Minorities** – "Other non-Hispanic" households, including Native Americans, Asian Americans, and Eskimos, are least likely to have telephone service in rural areas (82.8%), particularly at low incomes (64.3%). Black and Hispanic households also have low telephone rates in rural areas (83.2% and 85%), especially at low incomes (73.6% and 72.2%). As in 1994, Blacks have the lowest PC-ownership rates in rural areas

Figure 7: Percent of U.S. Households with a Computer by Income

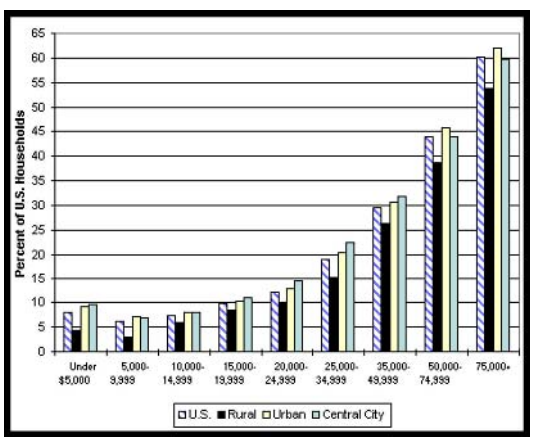
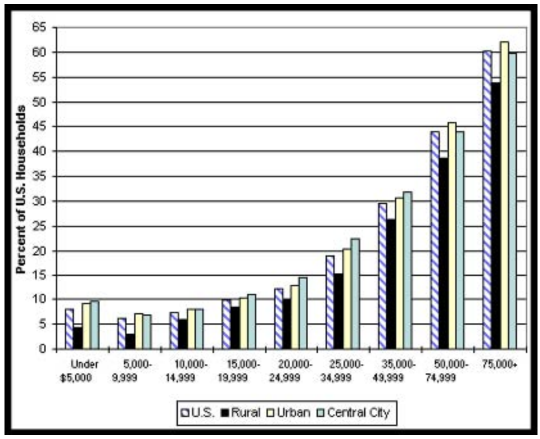


Figure 8: Percent of U.S. Households Using the Internet by Income



(14.9%), followed by Blacks and Hispanics in central cities (17.1% and 16.2%, respectively). On-line access is also the lowest for Black households in rural areas (5.5%) and central cities (5.8%), followed by Hispanic households in central cities (7.0%) and rural areas (7.3%).

To put this in simple terms: a child in a low-income White family is three times as likely to have Internet access as a child in a comparable Black family and four times as likely as children in a comparable Hispanic household.

- **Young Households** — Young households (below age 25) also appear to be particularly burdened. Young, rural, low-income households have telephone penetration rates of only 65.4%, and only 15.5% of these households are likely to own a PC. Similarly, young households with children are also less likely to have phones or PCs: those in central cities have the lowest rates (73.4% for phones, 13.3% for PCs), followed by urban (76% for phones, 14.5% for PCs) and rural locales (79.6% for phones, 21.2% for PCs).
- **Female-Headed Households** — Single-parent, female households also lag significantly behind the national average. They trail the telephone rate for married couples with children by ten percentage points (86.3% versus 96%). They are also significantly less likely than dual-parent households to have a PC (25% versus 57.2%) or to have on-line access (9.2% versus 29.4%). Female-headed households in central cities are particularly unlikely to own PCs or have on-line access (20.2%, 6.4%), compared to dual-parent households (52%, 27.3%) or even male-headed households (28%, 11.2%) in the same areas.

The data reveal that the digital divide — the disparities in access to telephones, personal computers and the Internet across certain demographic groups–still exists and in many cases has widened significantly. The gap for computers and Internet access has generally grown larger by categories of education, income and race. This remains the chief concern as those already with access to electronic resources make rapid gains while leaving other households behind. We are witnessing the wholesale disappearance of work accessible to the urban poor. Without intervention, unemployment, poverty, and out-migration will likely increase, exacerbating the structural problems typical of rural areas (OTA, 1996).

In Australia, the picture is very similar. The report "Women's Access to Online Services," produced by the Office of the Status of Women in December 1996, states: "The Governments' focus on commerce has meant that the social consequences of becoming an 'information society' have been largely ignored. This may have been exacerbated by the apparent lack of women in decision-making positions in industry and relevant departments." The most recent data from the Australian Bureau of Statistics (1998) estimated 262,000 users who indicated use of the Internet at home with about 178,000 being men and 84,000 women (68%:32%). Women's representation amongst email users was even lower — at only 26%. Women over the age of 55 were extremely poorly represented. However, perhaps a more important issue is "What access opportunities are open to women who don't have a computer and modem at home?" AGB McNair estimate that in the region of only 13% of Australian women over the age of 14 have ever accessed the Internet!

Other countries' digital divides also persist; the percentages are simply higher for the have nots. For example, Egypt's "haves / have nots" ratio, a lower-middle income country as defined by the World Bank[1], represents less than 8% of its 60 million plus population.

There are astonishing exceptions to the rule–one example is women farmers. The DSS CRP case studies found that women farmers "were the enthusiasts, the main drivers, while their husbands, if they had no prior computer experience, were reluctant to touch the CIN (Community Information Network)." Weather information, farming practices, health and education were all foci but further email was used to develop support networks, thereby reducing social and cultural isolation. Strangely it is not only those women typically identified as culturally isolated (aboriginal, non-English speaking, remote communities such as mining) but also professionally educated women whose need for professional support, continuing education and contact with like-minded peers is not adequately met.

Increasingly, education, health, legal services and social communications are moving to computer-based technology. The success of the Ipswich Global Infolinks project "SeniorNet" is another startling example. One resident said "I personally find the Internet to be a fascinating medium where any information seems available. … [it] opens up a whole new world for elderly people and keeps the mind active … there is no age limit to having a good time surfing the net "(des Artes, 1996).

The Internet is increasingly viewed as the window to the global economy. Is then the Internet the secret weapon for the have-nots? Is it for the masses? One may argue that what subsistence farmers in Afghanistan, or Korea, or Cambodia need is NOT high-tech science and complex systems, but immunizations, basic literacy, disease and drought-resistant cereals and oilseeds, simple pumps, or deep-drop toilets. The fallacy of the pro-Internet argument is that it ignores the social and economic implications of the technology, as highlighted in this discussion.

A second argument in favor of the technology is that it will assist developing countries in leapfrogging stages in the development process. Many highly successful initiatives are taking place in developing countries to promote community-based Internet access for health (effective water sourcing, sanitation, bioengineering of crop production), educational (electronic network of schools), and other applications. The Mbendi AfroPaedia Web site (www.mbendi.co.za), the pan-European FRIENDS (Farming and Rural Information Expertise and News Dissemination Service) project, and the Mediterranean Institute of Teleactivity (IMeT) are representative of these types of initiatives (Stratte-McClure, 1999). Compelling examples demonstrate the pay-off: In rural southern Ghana, petrol stations are able to place orders with suppliers by phone when previously they could only be made by traveling to Accra; in Zimbabwe, one company generated $15 million of business by advertising on the Internet; in China, a little girl's life was saved when her doctor posted her symptoms to an Internet discussion group and received an immediate answer. Sam Pitroda, Indian government advisor, states, "IT is not a luxury but VITAL to basic activities, such as bringing food to market, preventing drought, a major source of new jobs and wealth." The conundrum is that sustainable development is an immensely complex process having its roots in educational and infrastructural building; what then is the role for the Internet in this process?

HOW CAN THE INTERNET ADDRESS THE CHALLENGE?

It is recognized that an educated population with skills and knowledge in information technology is an instrumental part of sustainable development. The irony is that while the volume of information and knowledge that is available is increasing, the percentage of the world population able to have access to and derive value from it, seems to becoming smaller. The gap between the haves and the have nots is increasing significantly — both on a global and local basis (Novak & Hoffman, 1998). The magnitude of the challenge within countries is related to income distribution and country size. Central and Eastern European countries enjoy high teledensities in relation to their income levels because they have more even levels of income distribution than other regions (ITU, 1998:1.2.3). In terms of size, smaller countries are more able to reinvent themselves than countries such as China with massive populations and huge geographic expanse. Ireland and Singapore are good examples of small countries who, through aggressive national policy towards technology and education, repositioned themselves in the global market.

Is the Internet the secret weapon to bring equality to the masses? — to close the gap? Fact one: Information represents power in both the political and economic spheres. Fact two: Almost every emerging society has made it a priority to participate in the global information society, bearing witness to the belief in its ability positively to effect their country's well-being. Fact three: The Internet is the technological innovation that can provide access to the same markets, and the same information within the same time frame as is the case with more developed countries. It would seem therefore that the answer to the question is "yes" — but that access is a necessary albeit insufficient solution. What then are the implications?

The traditional approach for introducing technological innovations has been through the educational system and the workplace. The problem is that a significant portion of the have-not segment does not participate in these venues. A nontraditional approach must be taken.

If access to the have-nots is to be achieved, then technological innovations, such as the Internet, need to be brought specifically to the target group and on their level. Venues where Internet awareness, exposure, and ultimately, familiarity need to be developed. Candidate sites include communal gatherings such as the post office, hospitals, banks, and the local merchant. Furthermore, the have-nots must perceive value, an incentive to take the steps to go beyond simple awareness to becoming an actual user of the technology. The success of this effort is necessarily linked with the extent to which applications are socially and culturally appropriate and specifically address those daily life issues that concern the intended users, such as registering to vote, access to government information, access to medical information and assistance, or bus schedules.

In the local village or community where the deployment is being made, co-opting a key individual is instrumental to success. The key individual receives the benefits of training plus the respect of his or her community as the knowledge broker. They are instrumental in introducing the technology to others. Use of the systems, at least initially, will likely need to be heavily if not totally subsidized. This certainly raises the bar for many developing countries and also illustrates how country size quickly becomes a significant factor.

Egypt is an example of a country that developed a model that includes education and training, infrastructure, and IT in general and Internet access over time, all together. Moreover, it developed applications that would be culturally and socially appropriate so as to gain widespread support for the effort. But, results do not come overnight: There is a requirement for champions and long-term commitment on the behalf of the sponsor—in this case, the Egyptian government. In the late 1980s, Egypt began to deploy computer-based systems in its 27 governorates, creating Information and Decision Support Centers (IDSC) (Nidumolu et al., 1996; Kamel, 1997, 1995; El-Sherif & El-Sawy, 1988). The effort was part of a comprehensive plan to introduce and rationalize the use of information technology in key sectors in the economy. Over time, the IDSCs have been extended into the local villages and more rural areas. There are currently 1,102 IDSC facilities. Technology Community Centers represent the most recent efforts to introduce and rationalize the use of information technology in general, and specifically the Internet, to the general populace (Loch et al., 1999). The focus of the community centers is on children up to the age of 20. Egypt's income distribution and population demographics are typical of many developing countries. Less than 10% of the population comprises the haves subset of the population. More than 60% of its population is under the age of 30; of that segment, more than 50% is under 20 years of age. The implication is that the extent to which these segments are exposed to advanced technologies, and educational and training opportunities is highly correlated with the future economic well-being of the country.

The International Telecommunication Union's (ITU) Telecommunication Development Bureau (BDT) has a program for Multipurpose Community Telecentres (MCTs) for rural and remote areas. The ITU is working in partnership with other international organizations and the private sector, installing pilot MCTs in and around a dozen countries. The operating principal of this effort is the information premise: Access to information [services] brings about improved access to the local marketplace which in turn enhances economic growth and which ultimately impacts the global competitiveness of the country. MCTs articulate the premise slightly differently, also arguing that access to information services can also help to lessen isolation and combat the problem of brain drain from rural to urban areas. Contrary to past history where technological innovations were contributors to mass migration of people, the Internet might allow people to remain in place while making available needed information.

The project in Uganda subsidized by the BDT exemplifies the above. The MCT will be installed in Nakaseke to provide individuals with access to telephones, facsimile machines and computing facilities, including Internet access. It offers training, technical support, and professional guidance to produce electronic information reflecting local knowledge and requirements. The library is integrated into the telecentre. The MCT will provide support to teachers in the local school system through information support to the school libraries, the provision of visual resources, training for teachers in the use of computers and distance education. The staff of the local hospital will use the facility for telemedicine applications, continuing education for health staff, and access for local health worker to medical-related resources on the Internet. Other targeted local user groups include small businesses and farmers, local councils, the women's training organization, nongovernmental organizations, and the general public (ITU, 1998: Box 5.1).

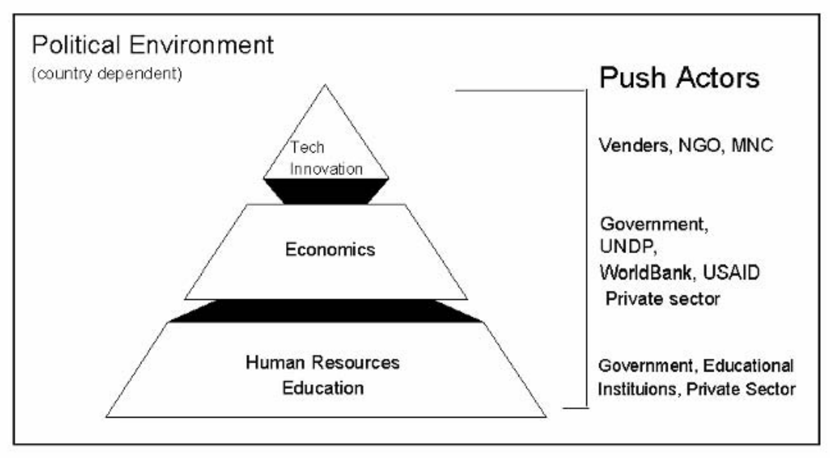
SUMMARY OBSERVATIONS

True, the Internet and its associated developments, such as the World Wide Web, are a developed global phenomenon. True, the gap between the economically advantaged and disadvantaged continues to increase in both developed and developing economies. With the experiences in Egypt and Uganda as exemplars, we can make several observations that may be useful to other organizations and governmental agencies considering such initiatives or for researchers examining such initiatives.

First, existing articulated demand for technology-based services by the have not group for such services is likely to be small to nonexistent. Hence the effort is very much characteristic of a push phenomenon (Gilbert, 1996; Gurbaxani, 1990). Central and local government authorities, international agencies, and leading entities from the private sector are playing, and must continue to play, key roles. Aggressive IT policy by the Singaporean government transformed Singapore within a twenty year time frame. Other countries, such as Uganda and Egypt as highlighted in this paper, are making inroads, but one must acknowledge that it is a long road to travel.

Second, there are three levels of challenges that are part of this effort. The first level is a human resource challenge. The availability of quality education and the level of literacy are both part of this challenge. The second level is the economic challenge. On an individual basis, the ability to pay for service is minimal. This places additional pressure on the providers to make the service inexpensive and widely available. On a country/governmental level, such efforts stretch the economic resources of the providing agencies. The geographic size, and population distribution and size are all factors that make this level a particularly difficult

Figure 9: Three Challenges to Technological Innovation Deployment



challenge. The magnitude of the task for China, for example, far exceeds that of Singapore simply due to its geographic span and population demographics.

The third level is the technological innovation itself. In the case of the Internet, a base level of infrastructure must be in place to be able to deliver access to the Internet, and in turn, access to the global marketplace. All three levels are interrelated. The simple availability of the technology is insufficient; training to support its use must also be available. All levels reside in a political environment which varies from country to country. Figure 9 depicts these levels in context.

THE REAL CHALLENGE?

Information technology is generally perceived as a major facilitator for globalisation, with the implication that hitherto underdeveloped regions can now gain access to worldwide resources and expertise, which will in turn lead to enhanced economic development. Globalisation theorists, however, argue that it is only capital that has escaped the confines of space (Bauman, 1998; Beck, 2000). Capital has gained almost unlimited, instantaneous mobility, whereas people remain relatively immobile. One could argue that the development of global networks serves only to enhance the more developed nations and support the most dominant values leading to increased exploitation of the less developed nations and the more disadvantaged sectors of society (Castells, 2000).

A powerful tool, such as the Internet, used creatively can serve to begin to reduce the growing and persistent gap between the haves and the have-nots but only if we begin to address the kind of problems identified in this paper.

Consider these words which come from the Cyberspace declaration of independence (Barlow, 1996):

- Cyberspace is a world that is both everywhere and nowhere
- A world that all may enter without privilege or prejudice accorded by race, economic power, military force, or station of birth
- A world where anyone, anywhere may express his or her beliefs
- A world where legal concepts of property, expression, identity, movement and context do not apply
- A world of no matter.

It is in our hands to make our new world matter and for it to be a cyber civilisation to be proud of. Otherwise the proud boast that: "We will create a civilisation of the Mind in cyberspace. May it be more humane and fair than the world your governments have made before" (Barlow, 1996) will remain empty rhetoric.

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Chapter III

Internet Privacy: Interpreting Key Issues

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ABSTRACT

The phenomenal growth in Internet commerce in recent years has brought privacy concerns to the fore. Although privacy as a concept has been well understood with respect to brick and motor businesses, there is limited research in identifying major issues of concern related to Internet privacy. This paper systematically identifies the major Internet privacy concerns. Data for the study was collected through two panels and subjective evaluation.

INTRODUCTION

The Internet has transformed the way in which goods are bought and sold. Forrester Research predicts retail sales on the Internet to grow from less than 1% in 1999 to 6% by 2003. According to Gartner Group, convenience and time saved are two of the main incentives for users to buy online. At the same time, however, research conducted by PriceWaterhouseCoopers suggests that during the 1999 Christmas season, 18% of all customers who purchased online were 'dissatisfied' with their experience. A Business Week/Harris Poll (see *Business Week* of March 20, 2000) survey reported that 41% of online shoppers were very concerned over the use of personal information. Among the people who go online but have not shopped, 63% were very concerned. Clearly, as Keeney (1999) suggests, maximizing privacy is a fundamental objective related to Internet commerce.

The purpose of this paper is to identify issues related to maximizing Internet privacy. The paper is organized into five sections. Following a brief introduction, section two explores the notion of Internet privacy and how various researchers have attempted to understand the concept. Section three presents the study design. Section four is a discussion of research findings. Section five presents the conclusions.

INTERNET PRIVACY

Internet privacy can be defined as the seclusion and freedom from unauthorized intrusion. The key word in the definition is 'unauthorized.' Although we may not like that our personal information regarding our purchases and habits to be monitored and stored in databases around the country, we are at least usually aware that it's happening. However an unauthorized intrusion to collect personal data marks the beginning of privacy infringement. Various opinion polls have shown increasing levels of privacy concerns (Equifax, 1990, 1992). The 1992 Equifax study reports a survey indicating nearly 79% of the Americans being concerned about personal privacy and 55% suggesting that security of personal information was bound to get worse by year 2000. Indeed this has happened. Fairweather and Rogerson (2000) report that it is technically easier than ever before to gather and search vast amounts of personal data. Hence it has become easy to track individuals across the globe as they leave the data shadow behind — through the use of gas stations, cash machines, logging on to check e-mail.

A March 1999 Federal Trade Commission (FTC) survey of 361 Web sites revealed that 92.8% of the sites were collecting at least one type of identifying information, such as an address. Furthermore 56.8% of the sites were collecting at least one type of demographic information. The FTC study also found that over one third of the sites did not have a privacy disclosure notice on the site. Even in cases where the privacy disclosure notice had been posted, only 13.6% were following the FTC's fair information practice guidelines.

Previous literature on privacy — not necessarily Internet privacy — has critiqued the majority of opinion surveys based on the assumption that information privacy is not a uni-dimensional construct, i.e., focusing on the level of concern alone, rather than understanding the nature of concern. In response, Smith et al. (1996) suggest four dimensions of the construct "individuals' concerns about organizational practices in managing information privacy." These factors were: collection, unauthorized secondary use, improper access, and errors. Smith et al.'s (1996) research, although providing a very useful instrument to measure individuals' concern about information privacy, does not necessarily consider privacy issues in relation to Internet use. Clearly the use of the Internet to conduct business has gained prominence in recent years and the converging trends, competitive and technological, pose interesting privacy challenges (cf. Culnan & Armstrong, 1999).

There are two reasons for an increased importance of Internet privacy concerns, as opposed to simple information privacy issues relevant to any brick-and-mortar business. First, the increasingly competitive business environment is forcing companies to collect a vast amount of personal information. Many a time there is good intent in doing so, since many businesses may seriously want to customize their products and services for the benefit of the consumer. However the security of personal data and subsequent misuse or wrongful use without prior permission of an individual raise privacy concerns and often end up in questioning the intent behind collecting private information in the first place. Second, the advances in information technology have not only made it possible to record personal information at the point of sale, but also map the patterns of online behavior. Although this is a useful marketing ploy (Bessen, 1993; Glazer, 1991), it certainly overwhelms the customer and hence there are numerous privacy concerns. Similar issues about overwhelming the customer through excessive use of technology have been voiced in the literature (see Dhillon & Hackney, 1999; Ciborra, 1994).

With respect to the two reasons identified above, the question of fairness in collecting personal information needs to be understood adequately. Fairness, with respect to Internet commerce, can be considered at two levels. As Glazer (1991), and Milne and Gordon (1993) contend, fairness could either be a component in the 'social contract' or related to the procedure followed for a particular activity (Lind & Tyler, 1988; Folger & Bies, 1989). When individuals willingly disclose personal information for non-monetary gains, such as higher quality service, privacy concerns are limited as long as the concerned organization upholds its side of the social contract. Individuals will clearly continue engaging in the social contract as long as the benefits exceed the risks, to a point where an individual begins trusting the organization. This is evidenced by many of the new generation Internet businesses.

Barnesandnoble.com and Yahoo, for example, have clear-cut privacy policies, thereby facilitating in developing trust over a period of time. On the other hand, ediets.com believes in overwhelming the customer with e-mails and offers once personal details have been recorded.

Fairness is also linked to the procedure that might be followed in a particular activity. Clearly fairness of the procedure, as opposed to the nature of the outcome (Lind & Tyler, 1988), is a clear determinant of the level of privacy concern an individual might have. Some Internet businesses are now beginning to place importance on procedural fairness. In many cases the Web sites first give a notice as to why personal information is being collected, its usefulness and the manner in which it would be kept secure, then the consent is sought as to the manner in which an individual's personal information would be used. As would be evident, procedural fairness is closely coupled with social contract and trust. If an individual feels that in spite of procedural fairness, the social contract in the exchange of private information is not maintained, it would clearly lead to loss of trust and integrity of the organization. On the other hand if an individual willingly gives private information in lieu of some social or economic benefit, but the procedure used in collecting and maintaining the information is not fair, again it would lead to concerns about privacy infringement, trust and integrity of the process.

Given an understanding of various aspects of Internet privacy, as discussed in the literature, our intention is to understand the various issues that could be of potential concern for individuals. The next section describes the multi-method adopted to identify such issues.

STUDY DESIGN

In identifying issues related to individuals' concerns about Internet privacy, we set out to use a combination of two methodological approaches. The first relates to steps 1 and 2 as described by Schmidt (1997) while the second is related to the identification of means and fundamental objectives as described by Keeney (1999). A combination of these two approaches helped us to generate a list of issues that are of significant concern for individuals with respect to Internet privacy. Further research would enable us to validate the preliminary list and develop an instrument that would be useful in assessing the level of Internet privacy concern for an individual with respect to a particular online business.

This study was designed to span two main phases. Phase one followed Schmidt's (1997) approach to (a) discover relevant issues and (b) determine the most important issues. Phase two of the study followed Keeney (1999) in identifying the fundamental Internet privacy objectives of individuals and means objectives in achieving the fundamental Internet privacy objectives. Essentially Keeney's concepts were used to classify the output of Schimidt's second step.

Keeney (1999) stresses the importance of defining a decision context when identifying the objectives. He contends that the fundamental objectives together with the decision context provide a decision frame. Furthermore a decision context defines the alternatives to consider for a specific decision situation. In our study the decision context was the maintenance of individual privacy with respect to Internet use. We defined our overall objective as maximizing Internet privacy for individuals. According to Keeney, the decision context would imbed in itself a number of means objectives. These would be objectives that individuals would have with respect to maximizing Internet privacy. Our task was to not only identify fundamental Internet privacy objectives, but also all possible means objectives. We also wanted to rank all objectives in order of importance.

Phase 1

Our first step in Phase 1 was to unearth as many issues as we could from a panel of experts. Panel members, 11 in total, were invited to a brainstorming session and were asked to identify all possible objectives they would have in maximizing Internet privacy. The actual elicitation of objectives followed a 40-minute general discussion on Internet privacy issues and was moderated by the first author. The panel was representative of various experts in the field. There was one attorney, one former policeman, one network administrator, one sales and marketing professional, one software engineer, one dot-com entrepreneur, two full-time students and three ardent Internet users who had considerable experience in purchasing online.

The brainstorming session lasted little over an hour and the panelists identified 144 concerns/objectives. At this stage it was hard to differentiate whether these were merely concerns or were in fact Internet privacy objectives. Following the data collection exercise, the authors consolidating the list of objectives and posted it on their Web site. The consolidation process produced 70 objectives. The panelists were invited to visit the Web site to refine, add to or suggest deletions from this list. An online bulletin board was used to capture the responses. The respondents added another 15 objectives to the consolidated list to produce a total of 85 objectives.

Our second step was to determine the most important issues. We presented our list of 85 objectives to a group of 16 IS executives. These executives represented five different industries: government, hotel, pharmaceutical, health care and IS consulting. The average work experiences of the IS executives was five years. The group was asked to rank the top 10 issues from the list of 85 objectives.

We followed the guidelines of selecting at least 10% following Schmidt (1997). No ties were allowed. The results were consolidated and presented once again to the group. Open discussion resulted in clearly identifying the top five objectives. These objectives appear in Table 1 in rank order.

Phase 2

Phase 2 involved the identification of means objectives with respect to maintaining Internet privacy. The argument used in identifying the means objectives was that any objective that was not a top issue of concern clearly contributed in some way to one of the top issues. The remaining 80 issues from Phase 1 were subjectively evaluated with an intent to formulate means objectives. This was a two-step process. First, issues with a similar meaning were clustered together. Second, a judgment was made whether an issue had merit to be a means objective on its own or was merely a part of a larger means objective. This process resulted in 18 means objectives. The majority of the remaining 62 issues were condensed into one of the 18 means objectives. Others did not necessarily relate to our overall objective and were hence not included. The means objectives (in no particular order) appear in Table 2.

DISCUSSION OF RESEARCH FINDINGS

This section presents a discussion of key Internet privacy issues. The intent is to provide an explanation of the top issues identified by respondents in this study in light of the literature and the means objectives.

The top issue is the potential for a Web site to sell the details of online consumers to a third party. While the use of personal information to further the cause of businesses has become a competitive necessity, the issue raised here suggests that the burden resides with online businesses to ensure that confidentiality of personal information collected is maintained. As identified in section two of this

Table 1: The Top Five Internet Privacy Issues

Rank #	Issue stated as objective
1	Companies should not sell personal information.
2	Adequate measures should be in place to prevent theft of personal information by a third party.
3	Eliminate the chance of ‘losing’ personal files.
4	Maximize security to deter ‘hackers’ from destroying the data.
5	Eliminate spam.

Table 2: Internet Privacy Means Objectives

Increased awareness to have firewall protection	**Boycott companies who do not have a privacy policy**
Provide credit card security assurance by third parties	**Use encryption in email communications**
Provide guarantees from shopping sites	**Online businesses should not collect personal information**
Enact stronger laws to protect consumer privacy	**Watch children online**
Tougher laws to protect consumer ID theft	**Strict penalties for violators of personal privacy**
Facilitate self-policing the Internet community	**Establish international standards on privacy**
Prosecute violators of laws	**Check authenticity of an online business prior to purchase**
Make spam illegal	**Increase self determination in providing personal information online**
Businesses should be required to have a privacy policy	**Providing personal information online should be discretionary**

paper, individuals may be willing to provide their personal information as long as they are receiving some benefit, i.e., increased customer service. This means that online businesses need to ensure 'procedural fairness' (Culnan & Armstrong, 1999). Individuals may not be interested in giving out personal information on first contact with an online business, but a trust may develop over a period of time. Hence, as identified in this research (see Table 2), it is important for businesses to self-determine what they should divulge to a third-party. Moreover providing personal information online should be discretionary. Such actions would go a long way to enhance the credibility and integrity of online businesses and enable them to remain competitive ethically.

Establishing adequate measures to prevent identification theft is another critical concern identified by this research. This issue can be addressed at two levels: 1) the security of personal information once it has been collected; and, 2) establishing tougher laws to prevent consumer ID theft. When dealing with security of information internally, establishment of a security policy and a general culture of trust and high integrity will be beneficial (Dhillon & Backhouse, 2000), as well as other organizational issues that are beyond the scope of this paper (see Dhillon, 1997 for details). There is also a need to have tougher Internet privacy laws, such that violators could be adequately prosecuted. At the present time, there is no doubt that US and European governments are responsive to Internet privacy demands. Research has shown that increased levels of privacy regulation are a function of the level of data processing environment in a particular country and increased government involvement in privacy protection (see Milberg et al., 2000; Flaherty, 1989).

Several of the fundamental issues identified by the respondents in this research related to establishing adequate measures to protect information from inappropriate sale (issue #1), but also from accidental loss (issue #3), and from deliberate attack by ‘hackers’ (issue #4). In the US, the FTC has also given due credence to the protection of personal financial information. The onus however has been placed on individual organizations to ensure responsible data manipulation, implementing encryption standards and maintaining secure servers. Although many online businesses, especially banks, have security very high on their agenda, many other businesses with an aspiration to develop customer confidence have turned to third parties for ‘seals of approval.’ In recent years, one means has been the Web Assurance Seals. Organizations such as the Better Business Bureaus, Certified Public Accounting Firms, and/or organizations devoted to security, privacy or dispute resolution award seals of assurance to Web sites that meet certain criteria. The seals of assurance cover such areas as privacy, security, transaction integrity/completeness, business disclosures, quality control processes, and consumer recourse. These seals often highlight the close relationship between privacy and security issues. Clearly there were concerns with maintaining privacy of personal information when connected through a cable modem, from viruses and Trojan horses. Whether deliberate or accidental, the issue raised here is that any data provided to a Web site must be protected.

An issue related with electronic communication is that of spam. Receiving unsolicited e-mail is certainly an invasion of privacy. Some businesses feel that inundating consumers about their products and services is going to increase their sales. However the converse may be true. Unsolicited e-mails are irritating and our respondents seemed to have a very strong opinion about them. Some of the popular internet e-mail services such as Hotmail and Yahoo! now include a “spam guard” that detects bulk mail and automatically directs the spam to the trash folder. There are now also facilities to block mail from the more technically-savvy spammers that do not use bulk mail addresses in their e-mail header. According to the respondents in this study, spam e-mail is seen as a sufficiently irritating phenomenon that there are calls to make spam illegal.

In this section we have discussed various aspects of Internet privacy which our respondents considered to be fundamental concerns. Clearly there are no simple answers to the issue of Internet privacy, but our fundamental issues would help in starting a dialogue.

CONCLUSION

This paper has identified an individual's concerns with respect to Internet privacy. Five fundamental and eighteen means objectives were identified, essentially suggesting that in order to adequately manage the fundamental concerns, concrete steps have to be taken with respect to the means objectives. While the governments and organizations gear up their resources to tackle Internet privacy concerns, it is prudent to engage in self-regulation. A way ahead could be through the creation of private rights of action for individuals who have been harmed. Following on from research presented in this paper, work is needed to develop measures to assess the extent to which individuals are comfortable with Internet privacy within the context of a particular business. This would help businesses to create new policies and reassess existing ones.

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Chapter IV

Knowledge Management Enablers within an IT Department

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ABSTRACT

In today's competitive global economy, characterized by shorter product lifecycles, increased employee turnover and ubiquitous information technologies, an organization's ability to manage knowledge may be the only remaining source of competitive advantage (Drucker, 1995, 1999; Kogut & Zander, 1992; Nonaka, 1994; Winter, 1987). Even though a number of researchers have outlined the importance of adopting knowledge management (KM) practices and many organizations have given lip service to the term, *there is still some ambiguity concerning what KM actually is (Malhotra, 2000b), and little attention has been paid to factors that enable effective KM to occur (Nonaka & Takeuchi, 1995). This research uses technical and human-centric approaches combined with Holsapple and Joshi's (1998, 2001) Kentucky Initiative to investigate KM within an information technology (IT) department. Based on our case study, modifications to Holsapple and Joshi's architecture of a KM episode, a model of execution of knowledge manipulation activities and a model outlining factors enabling effective KM are proposed.*

INTRODUCTION

In today's competitive global economy, characterized by shorter product lifecycles, increased employee turnover and ubiquitous information technologies, an organization's ability to manage knowledge may be the only remaining source of competitive advantage (Drucker, 1995, 1999; Kogut & Zander, 1992; Nonaka, 1994; Winter, 1987). Even though a number of researchers (Drucker, 1995, 1999; Grover & Davenport, 2001; Kogut & Zander, 1992; Nonaka, 1994; Winter, 1987) have outlined the importance of adopting knowledge management (KM) practices and many organizations have given lip service to the term, there is still some ambiguity concerning what KM actually is (Malhotra, 2000b), and little attention has been paid to factors that enable effective KM to occur (Nonaka & Takeuchi, 1995). Some researchers and practitioners hold an information processing view of KM, seeing KM as a computer system that helps an organization manage knowledge; others take a human-centric view seeing KM as primarily a social process. The purpose of this research project is to explore how KM actually occurs within a small information technology (IT) department. A by-product of this investigation is identification of some factors that enable effective KM within the IT department (Table 1) and a model of the execution of knowledge manipulation activities within the IT department (Figure 2).

This project stemmed from discussions between industry representatives on Texas A&M University's Center for the Management of Information Systems (CMIS) advisory board and researchers. Centering on the KM "buzz," discussion soon turned to debate as information processing views and human-centric views of KM clashed. The information processing view, which has been popular in the trade press and widely implemented in practice (Davenport, DeLong & Beers, 1998; Hansen, Nohria & Tierney, 1999; Malhotra, 2000c), sees KM as archiving explicit knowledge of individuals in technology-based repositories (Applegate, Cash &

Mills, 1988). The human-centric approach (Brown & Duguid, 2000; Chae & Courtney, 2000; Churchman, 1971; Courtney, 2001; Davenport, 1994; Hansen et al., 1999; Malhotra, 2000a, 2000c; McDermott, 1999; Mitroff & Linstone, 1993; Pan & Scarbrough, 1999; Wenger & Snyder, 2000) incorporates organizational, social and individual dimensions into KM, purporting that "current technology cannot replace the imagination and creativity in human minds, tap the tacit dimensions of knowledge creation and translate information into meaning" (Malhotra, 2000c, p. 10).

Because of this debate, both practitioners and researchers at the CMIS meeting decided exploring KM concepts in a real setting would help both groups better understand what KM is and how KM occurs. We chose the IT department at Texas A&M University's Mays College of Business as the subject for this case study.

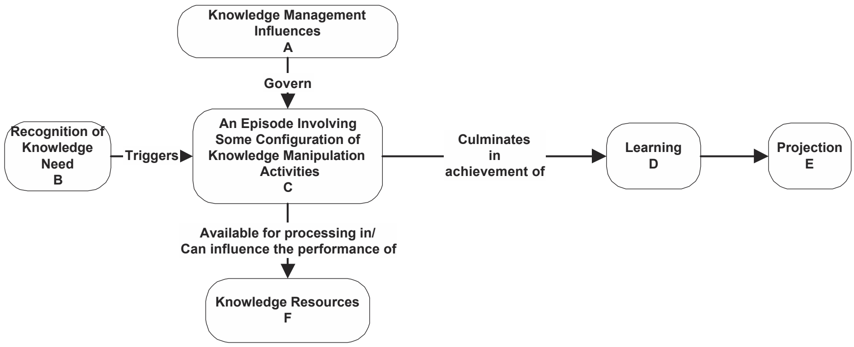
In the next section we discuss the chapter's theoretical background, Holsapple and Joshi's KM framework. Then, our research method is detailed. A proposed model of KM enablers and an explanation of how KM occurs within the IT department follow this. Finally, the conclusion discusses the contributions and managerial/theoretical implications of this research.

THEORETICAL BACKGROUND

Before explaining how KM occurs within the IT department, we must clarify the meaning of KM and our framework for organizing the discussion of KM within the IT department. This research project adopts and is organized according to Holsapple and Joshi's explanation of an organizational KM episode (Figure 2) as "the application of knowledge manipulation skills in performing knowledge manipulation activities that operate on the organization's knowledge resources to achieve organizational learning and projection; this process is both facilitated and constrained by KM influences and is triggered by a knowledge need" (1998, pp. 3-4).

KM influences (Box A in Figure 1) "govern how the conduct of KM unfolds in an organization" (Holsapple & Joshi, 1998, p. 4). The Holsapple and Joshi framework identifies managerial, resource and environmental influences. "Governed by KM influences, organizational participants execute knowledge manipulation activities (Box C in Figure 1) as an expression of their knowledge manipulation skills" (Holsapple & Joshi, 1998, p. 10). Knowledge selection, knowledge acquisition, knowledge generation, internalization and externalization are all knowledge manipulation activities, which operate on knowledge resources, (Box F in Figure 1) to create organizational value. Knowledge resources include schema and content resources; schema resources consist of purpose, strategy, culture and

Figure 1: Architecture of a KM Episode During the Conduct of KM (Adapted from Holsapple & Joshi, 1998, 2001)



infrastructure; content resources consist of participant knowledge and artifacts. Organizational value is the result of achievement of organizational learning and projection. Organizational learning is a process that results in enhancement of internal competencies, whereas projection results in enhancement within an organization's environment (Holsapple & Joshi, 1998, p. 4).

Next, we discuss the research method and the department's background. This is followed by our results, which include using Holsapple and Joshi's KM episode as a guide for discussing factors enabling KM in the IT department and an examination of how KM occurs within the IT department.

RESEARCH METHOD

This case study (Emerson, 1983; Emerson, Fretz & Shaw, 1995; Gubrium & Holstein, 1997; Strauss & Corbin, 1998; Yin, 1994) consisted of focused interviews (Merton, Lowenthal & Kendall, 1990) with each of the five full-time members of the IT department at the Mays College of Business. A case study method was most appropriate since it provides a deeper understanding of the KM process within a real-world context, allowing us to test Holsapple and Joshi's model of how KM occurs and allowing us to develop a model of KM enablers. In addition, the IT department within the Mays College was chosen because the small department size would allow investigation of the entire KM process while the close proximity would allow a long-term relationship, thus enabling the study of KM over time.

Each interview was approximately 90 minutes. We used Holsapple and Joshi's Kentucky Initiative as a basis for formulating interview questions, which sought to uncover how KM occurs within the IT department. Both human-centric and technical components were considered. A combination of the OSI model and the general top-down business model for information systems provided a supplemental framework for analyzing KM from the technical perspective (Goldman, 1998). To achieve validity, each interviewer prepared and shared interview notes and perceptions with the other interviewers (Kilmann, 1999). There were between four and six interviewers at each interview. Interview data was also corroborated by internal written documentation. Follow-up interviews, electronic communication and review by members of the IT department helped clarify issues and validate observations (Lawler et al., 1999).

Our method had two shortcomings. Our study dealt with a single IT department; future research studying KM within other IT departments would help validate our models. Measuring knowledge is difficult and effective KM is difficult; research better operationalizing effective KM would be valuable (Baum et al., 2000; Holtshouse, 1998; Teece, 1998).

Formed in early 1996, the IT department is primarily responsible for maintaining the Mays College of Business' computing infrastructure. The department has a flat organizational hierarchy with three full-time employees reporting directly to the associate dean and one full-time employee reporting indirectly to the associate dean. Although the associate dean is responsible for a number of other programs within the Mays College of Business, in his role as the administrative head of the IT department, his responsibilities include setting and enabling the department's overall direction. In analyzing the duties of each role in the operational IT department, there is a strong interrelationship between and within the four operational roles. For instance, the systems analyst II and the network administrator equally share responsibilities for five of the 10 major responsibility areas, and all but three major responsibility areas have explicit interrelationships or joint responsibilities among the four operational department members.

KM ENABLERS

The measure for effective KM is whether the IT department members feel the department's knowledge base has increased, is accessible and can be made available to external recipients. Aware that asking these questions directly may yield biased results, we asked questions that would uncover whether effective KM was occurring, but did not pressure interviewees to respond in certain ways.

Table 1 shows a model of KM enablers derived from our analysis of KM within the IT department. While the research project investigated KM from both organizational and technical dimensions, Table 1 shows KM enablers as overwhelmingly organizational. While the IT department is heavily involved with technology, they did not see KM as a technical process and rarely cited technology as a KM enabler. The table shows factors appearing to enable KM were present in every part of a KM episode: knowledge influences, knowledge manipulation

Table 1: KM Enablers

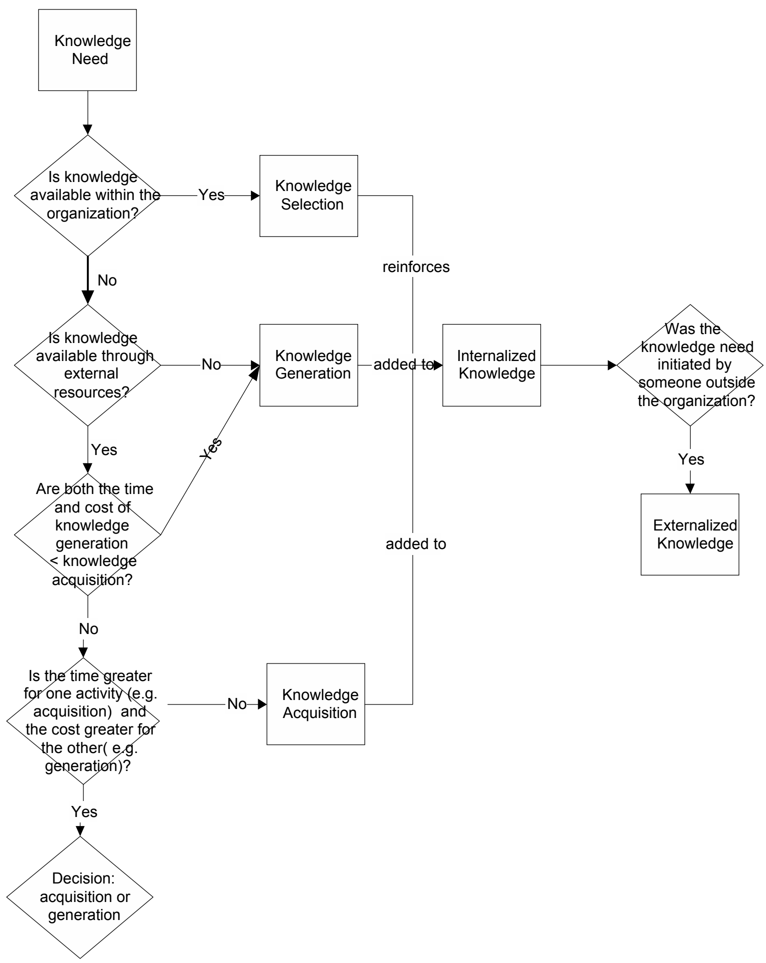
Knowledge Influences	Knowledge Manipulation Activities	Knowledge Resources
<u>MANAGERIAL:</u> **Coordination:** managing dependencies so that in a KM episode knowledge selection occurs first, knowledge acquisition occurs when knowledge selection fails and when the time and cost of knowledge generation exceeds the time and cost of knowledge acquisition **Control:** hiring employees that "fit in" and physical security protects existing knowledge; evaluating existing knowledge quality and generating new knowledge through personal feedback, surveys, and experiments **Leadership:** supporting learning, encouraging teamwork and open communication, and tolerating failure	<u>KNOWLEDGE SELECTION:</u> facilitating socialization through weekly meetings; overlapping job responsibilities; open, shared work space; and a team-work culture	<u>PURPOSE:</u> striving to always deliver the best, emphasizing achievement of a "moving target"
	<u>KNOWLEDGE ACQUISITION:</u> having financial resources, having information and communication services available, linking performance appraisal to knowledge acquisition, encouraging relationships with potential external information sources	<u>STRATEGY:</u> embedding a continuous learning processes, financially supporting KM
		<u>CULTURE:</u> being team-oriented, warm, supportive, friendly, non-competitive, and emphasizing trust
	<u>KNOWLEDGE GENERATION:</u> facilitating department processes, empowering knowledge generation initiation, hiring employees with an appetite for learning, communicating openly, having well-developed participant knowledge, encouraging experimentation, desiring to improve processes, allowing socialization and reflection time	<u>INFRASTRUCTURE:</u> emphasizing responsibility sharing in job descriptions; interrelationships between roles and dual roles; sharing work space, meeting weekly, and having electronic communication systems; not promoting competition between employees with salary apportionments or hierarchical positions; linking performance appraisal to knowledge acquisition
<u>RESOURCE:</u> allocating financial resources for KM activities in direct support of the Mays College of Business's mission; for knowledge resource enablers see knowledge resources	<u>INTERNALIZATION:</u> having an open work area and weekly meetings, retaining employees, allocating time to develop artifacts	
<u>ENVIRONMENTAL:</u> network participation; monitoring a changing environment through benchmarking, environmental scanning, and socialization	<u>EXTERNALIZATION:</u> Understanding of purpose; making recipients aware of available services through training sessions, meetings, electronic communication, and the grapevine; allowing down-time and socialization	

activities and knowledge resources. The sections that follow further explain how KM occurs within the IT department and the enabling factors.

KM Influences

"KM influences (Box A in Figure 1) are concerned with what impacts an organization's conduct of KM and what governs its performance of knowledge manipulation activities" (Holsapple & Joshi, 1998, p. 4). Holsapple and Joshi identify three KM influences: managerial, resource and environmental. The paragraphs that follow explore each influence and its related aspects within the IT department.

Figure 2: Execution of Knowledge Manipulation Activities



Managerial Influences

In the IT department, the associate dean role is primarily responsible for managerial influences, which can include coordinating, controlling, measuring and leading the conduct of KM.

Coordination. The way KM unfolds within an organization is influenced by management's choices in coordinating dependencies within and between knowledge resources, other resources and knowledge manipulation activities.

Figure 2 shows the interrelationships of and the order in which knowledge manipulation activities are executed within the IT department. The figure illustrates that members of the IT department first utilize knowledge selection to see if required knowledge is available within the department's previously internalized knowledge. Executing knowledge selection first promotes effective KM because the ability to acquire knowledge previously internalized is more efficient than seeking knowledge from outside sources (knowledge acquisition) or regenerating the knowledge. Coordination of the culture/infrastructure interrelationship is one factor that allows knowledge selection to be executed first. In the IT department, performance appraisal is linked to shared and interrelated job responsibilities (examples of infrastructure) thus encouraging the development of a teamwork culture supporting knowledge selection. In addition, knowledge selection is also enabled by an infrastructure that does not promote competition between employees, thus discouraging knowledge hoarding. Some of the infrastructure mechanisms the IT department uses to discourage knowledge hoarding include: a flat organization, not force ranking employees and not apportioning salary increases.

By looking at the next knowledge manipulation activity in Figure 2, it appears that the IT department considers financial resources in choosing between knowledge acquisition and knowledge generation activities. The IT department's managerial influence encourages using financial resources to acquire knowledge when acquisition is more efficient than generation by coordinating financial resources and by linking employee performance appraisal (infrastructure knowledge resource) to knowledge acquisition activities such as continuing education. Knowledge generation is employed when it is less expensive and/or less time consuming than knowledge acquisition or when an alternative solution does not exist.

Control. Control is an ever-present issue within the IT department. Control is concerned with "ensuring needed knowledge resources are available in sufficient quantity and quality, subject to required security" (Holsapple & Joshi, 1998, p. 6). One dimension of control is protection, in terms of how the IT department protects existing knowledge resources. Management influences the IT department's methods for protecting its knowledge resources which include protecting artifacts with physical security and protecting culture and infrastructure with hiring practices recruiting employees that "fit in" with the existing department. We believe developing retention practices is another method of control an organization may consider. Retention practices rewarding employee longevity will ensure an employees' tacit and explicit knowledge developed over years of service remain available to the organization. Unfortunately, while these methods do protect existing knowledge resources, they also may inhibit further development of knowledge resources. Physical security can add bureaucracy to existing processes and new hires with different background can bring fresh thoughts.

Management also influences mechanisms for controlling the IT department's knowledge quality. Personal feedback, surveys and experimentation are the primary mechanisms for evaluating the quality of internalized knowledge within the IT department. These evaluating mechanisms resemble the "convincing" practices knowledge workers use in Schultze's work (2000). For example, the quality of knowledge that an IT member or members makes available to others is evaluated based on the recipient's existing knowledge and/or the recipient's application of this knowledge. For knowledge resources to improve, recipients must provide feedback, particularly when the knowledge fails (Argyris & Schon, 1996). A knowledge resource audit is another method for evaluating knowledge resource quality. The methodology for conducting a knowledge resource audit is still in early development (Baum et al., 2000; Hiebeler, 1996).

Leadership. Leadership is defined as "creating conditions allowing participants to readily exercise their knowledge manipulation skills, to contribute their own individual knowledge resources to the organization's pool of participant knowledge and to have easy access to relevant knowledge resources" (Holsapple & Joshi, 1998, p. 8). Leadership values that seem to promote KM within the IT department include: desire for teamwork and encouragement of open communication, supporting knowledge selection; support of learning (Nelson & Cooprider, 1996), supporting knowledge acquisition and knowledge generation; and failure tolerance, supporting knowledge generation.

Resource Influences

Knowledge, financial, human and other resources also have a bearing on how KM episodes unfold (Davenport et al., 1998; Holsapple & Joshi, 1998, 2001). Resource influences can both support and constrain the execution of knowledge manipulation activities (Giddens, 1984) and thus affect the development of knowledge resources. In the IT department, financial resources, which include funding, endowment, enrollment and tuition, affect the ability to acquire and retain human and material resources. In turn, human resources may engage material resources in the development of schematic knowledge resources, which then influence the deployment of financial resources.

For example, human resources help develop schematic knowledge resources which interact to support the IT department's mission of being a leader in the application of IT to educational processes. The financial resources of a $1 million dollar endowment and a $3 per student credit hour computer access fee are restricted and can only be used in direct support of the Mays College of Business' IT mission (Strategic Planning Committee, 1998). Because of the financial resource restriction, knowledge manipulation activities not in direct support of the mission are not allocated financial resources and thus not supported within the IT department.

Environmental Influences

In contrast to managerial and resource influences, organizations have little control over environmental influences. Competition, fashion/technology, markets, time and GEPSE (governmental, economic, political, social and educational) all influence KM. All five members of the IT department participate in large knowledge networks or so-called networks of practice (Brown & Duguid, 2000) similar to communities of practice (Boland & Tenkasi, 1995; Brown & Duguid, 2000; Wenger, 1998a, 1998b; Wenger & Snyder, 2000), but that cross organizational boundaries, such as the larger occupational communities (Van Maanen & Barley, 1984). Participation in these networks enables the department to use benchmarking studies, environmental scanning and socialization to evaluate environmental influences. This allows the IT department to constantly launch KM episodes acquiring external information.

Knowledge Manipulation Activities

The preceding section identified KM influences and explained how they guide, shape, enable and constrain the conduct of KM within the IT department. This section explores how the IT department executes knowledge manipulation activities, (box C in Figure 1). Knowledge manipulation activities include: knowledge selection, knowledge acquisition, knowledge generation, internalization, and externalization. Knowledge manipulation activities are performed on knowledge resources in the conduct of KM.

In the IT department, the five knowledge manipulation activities are interrelated (Figure 2). A knowledge need initiates knowledge selection to see if knowledge is available within the department. If knowledge is not available, and time and cost of knowledge acquisition is less than knowledge generation, knowledge acquisition filters information from external sources. This knowledge then becomes part of internalized department knowledge. If knowledge is not available through external resources, or the time and cost of acquisition exceed generation, knowledge generation is employed creating new knowledge using knowledge selection to draw upon previously internalized knowledge. When the department needs to project their knowledge to the external environment, internalized knowledge is tapped, affecting external resources. A feedback loop allows environmental evaluation of the IT department's internal knowledge. For internalized knowledge to advance, the department must both receive feedback and allow feedback to modify internalized knowledge.

The sections that follow discuss the five knowledge manipulation activities and factors within each activity that enable effective KM within the IT department.

Knowledge Selection

Knowledge selection involves "identifying needed knowledge within an organization's existing knowledge resources and providing it in an appropriate representation to an activity that needs it" (Holsapple & Joshi, 1998, p. 12). Within the IT department, knowledge selection is usually executed before other knowledge manipulation activities because socialization and the teamwork culture make internal knowledge easily accessible through face-to-face promotive interaction. Executing knowledge selection first allows participants to easily draw upon existing organizational resources rather than acquire this same knowledge from external resources or "reinvent the wheel" through knowledge generation. Hollingshead (1998) found being able to execute knowledge selection first can directly impact the quality of a member's work and decisions.

The first step in executing knowledge selection is identifying appropriate knowledge from internal resources. This may occur on an individual basis by comparing one's knowledge to the department's knowledge. In selection and acquisition, a participant may actively seek information or may passively filter incoming information based on preexisting knowledge needs. The process of identifying appropriate knowledge differs between the IT department's operational and strategic layers. Identifying relevant knowledge within the operational IT department consists of informal inquiries with an immediate turnaround time and/or an informal socialization process whereby members become aware of the location of varying types of knowledge. The informal socialization process is facilitated by the department's open, shared working area. Identifying knowledge existence between operational and strategic department members and between operational department members in different offices consists of both formal and informal inquiries, has a longer turnaround time and consists of a socialization process dependent on weekly staff meetings. Socialization as a knowledge selection enabler is supported by Hollingshead's (1998) work, which posits self-disclosure, conversations and shared experiences enable group members to learn who has what expertise.

Knowledge selection's second step involves capturing knowledge from within the IT department. This process is dependent on whether knowledge is tacit or explicit. Tacit knowledge capture occurs through socialization, enables the IT department to develop a system of shared meanings and facilitates effective communication. The IT department's open work area, overlapping job descriptions and teamwork-oriented culture enable tacit knowledge capture. Explicit knowledge is easier to capture than tacit knowledge because it "can be expressed in words and numbers, and is easily communicated and shared in the form of hard data" (Nonaka & Takeuchi, 1995, p. 8). Explicit knowledge may be captured verbally, electronically or through written documentation. The IT department's weekly meetings, socialization and communication infrastructure enable explicit knowledge capture.

The IT department organizes acquired knowledge, making it available to others. In tacit organization, tacit or explicit knowledge is organized into tacit knowledge by adopting mental-models or technical expertise of others (Nonaka & Takeuchi, 1995). Johnson-Laird (1983) explains mental models as a person's working model of the world created by the mind's creation and manipulation of analogies. IT department members also organize knowledge explicitly. For example, IT department members organize selected knowledge by files explaining decision steps and the ownership and purpose of server files.

By organizing captured knowledge, selected knowledge is once again internalized, increasing the depth of the organization's knowledge base. Socialization is necessary to transfer captured knowledge; however, knowledge explicitly organized (e.g., the knowledge in a computer file) is less dependent on socialization than tacitly organized knowledge (e.g., ways of prioritizing tasks). Socialization, which is promoted by weekly meetings, shared job tasks, an open working environment and a friendly culture facilitates knowledge selection within the IT department.

Knowledge Acquisition

In the IT department, knowledge acquisition occurs after knowledge selection fails to address a knowledge need (Figure 2). Holsapple and Joshi (1998, p. 12) define knowledge acquisition as "identifying knowledge in the organization's external environment and transforming it into a representation that can be internalized and/or used within the organization." In the IT department, financial support of external knowledge acquisition and an infrastructure making external information and communication resources easily accessible enable knowledge acquisition. For example, financial resources enable the IT department to acquire training and technology manuals, as well as attend seminars. Achievement of these activities is also linked to each member's performance evaluation. In addition, the department has access to a comprehensive library system, university classes, information services, the Internet, e-mail and a telephone system. The department is also encouraged to build relationships with potential sources of information such as vendors, students, recruiters and other IT personnel within other colleges and universities.

While knowledge acquisition differs from knowledge selection, the activities involved are similar. The sections that follow discuss the activities involved in knowledge acquisition in terms of differences from knowledge selection.

In knowledge acquisition, identification of appropriate knowledge from external resources occurs by comparing knowledge acquisition needs to environmental information sources. In evaluating the IT department's acquisition process, several generalizations exist. First, each participant and/or role has different and overlapping knowledge acquisition resources. Second, the executive role has more general, less technical knowledge acquisition resources than operational roles. Finally, participants rely on resources that have been successful in the past before exploring other knowledge acquisition resources.

As in knowledge selection, both tacit and explicit knowledge can be captured. However, because socialization episodes are more limited in knowledge acquisition, explicit knowledge is captured more often than tacit knowledge. IT department members use conversations, meetings and formal or informal written documentation such as memos, e-mail, manuals and on-line documentation to capture external knowledge.

The processes for organizing acquired knowledge are the same as selected knowledge organization processes. However, acquired knowledge may be explicitly organized into artifacts and computer-based participant knowledge more often than selected knowledge because reacquiring knowledge from external resources is more time consuming than reacquiring knowledge from internal resources. For example, acquiring knowledge from the network administrator regarding troubleshooting a malfunctioning server requires asking the network administrator, who is usually in close physical proximity. Reacquiring knowledge regarding compliance with the Americans with Disabilities Act requires contacting the governing authority, which without artifacts involves first determining who to contact.

This process of transferring acquired knowledge mirrors knowledge transfer within the selection activity. Relevant acquired knowledge will become part of the organization's existing knowledge resources through internalization and will be made available for future knowledge management episodes.

Knowledge Generation

Holsapple and Joshi (1998, p. 14) define knowledge generation as "a knowledge manipulation activity that produces knowledge by processing existing knowledge where the latter has been acquired by selection, acquisition and/or prior generation." The IT department uses knowledge generation in meeting knowledge needs when knowledge selection fails and when external knowledge is unavailable or too time consuming and/or expensive to acquire (Figure 2). Holsapple and Joshi (1998) identify several knowledge generation sub-activities: monitoring knowledge resources, evaluating selected or acquired knowledge, producing knowledge from a base of existing knowledge and transferring produced knowledge.

Once an organization determines new knowledge must be created, the organization must evaluate whether existing knowledge resources would be useful in generating this new knowledge. The process of evaluating existing knowledge for use in knowledge generation was difficult for the IT department members to articulate and therefore seemed to be tacit, based on each member's experience, feeling and cognitive approach. IT department members consider whether knowledge relates to a similar subject matter or process in evaluating knowledge useful in knowledge generation activities.

In knowledge generation, managerial influences and existing knowledge resources are enablers. The associate dean facilitates weekly meetings, helping IT department members assess effectiveness, improvement areas and action plans addressing challenges. Other managerial influences on knowledge generation include: empowering employees to initiate knowledge generation activities and hiring employees with an appetite for learning. Davenport, DeLong and Beers' (1998) research corroborates this finding.

Well-developed participant knowledge including understanding IT department processes and their impact, a culture of process improvement, an environment encouraging experimentation, and an infrastructure allowing socialization and reflection time enable knowledge generation in the IT department. Several authors (Garvin, 2000; McDermott, 1999; Nelson & Cooprider, 1996) corroborate these findings. Davenport and Prusak (1997) posited compensation systems rewarding knowledge generation enable KM; the IT department may consider this.

Produced knowledge becomes part of existing knowledge resources, is useful in future internal activities and can be transferred to external recipients.

Internalization

The previous sections explored how knowledge selection, knowledge acquisition and knowledge generation provide knowledge flows into the IT department's knowledge base. These knowledge flows alter existing knowledge resources through internalization (Holsapple & Joshi, 1998). Webster's dictionary (1993) defines internalization as "incorporating into oneself such things as values, patterns, cultures, motives and restraints as conscious or subconscious guiding principles through learning and socialization." The IT department's open work area, weekly meetings and periodic lunches enable internalization. Several authors (Davenport et al., 1998; McDermott, 1999) explain that these engagements build trust and create a common language. Developing employee retention practices and allowing time for artifact development also help preserve internalized knowledge. Holsapple and Joshi (1998, p. 13) identify several internalization activities: assessing and valuing knowledge, targeting knowledge resources, structuring knowledge and delivering knowledge representations.

Assessing and valuing knowledge involves actors filtering available knowledge and determining what knowledge to retain. In our field interviews, IT department members had difficulty explaining their criteria for internalizing knowledge, indicating a tacit process. Our field interviews did indicate a common criterion in internalization is awareness of projects that need or will need knowledge or interest in an area.

Once the IT department determines knowledge to internalize, they must determine which knowledge resources the knowledge will affect. Content resources will be more frequently and noticeably impacted than schema resources (purpose, strategy, culture and infrastructure). For example, operational IT members actively pursue selection, acquisition and generation activities to acquire new knowledge to meet identified needs. This results in content resource expansion such as new software manuals or new employees with certain technical experience. In developing content resources, schema resources may evolve. For example, new employees may alter the culture.

Affected content resources seem to be a function of type of knowledge manipulation activity used and department habits. In the IT department, recording knowledge easily obtained in knowledge selection is uncommon; therefore, knowledge selection targets participant knowledge. Because acquired knowledge is more difficult to obtain, participant knowledge and artifacts are the targets of acquisition activities. Generated knowledge will most frequently increase participant knowledge in the form of experience because knowledge generation frequently results in tacit knowledge. For example, IT department members may try a number of methods in troubleshooting equipment malfunctions; however, making explicit how the problem was solved is difficult.

While content resources are the primary targets of the operational level's knowledge manipulation activities, the strategic level activities target schema resources in selecting, acquiring or generating knowledge. This occurs by deliberately hiring employees with certain qualities or changing the infrastructure, strategy or stated purpose.

Nonaka and Takeuchi (1995) posit methods for structuring tacit and explicit knowledge for delivery to internal knowledge resources. Socialization and job rotation structure tacit knowledge, while written documentation, meetings, conversation and computer files structure explicit knowledge.

Externalization

Holsapple and Joshi (1998, p. 15) define externalization as "an activity that draws upon internalized knowledge acquired through selection, acquisition and/or generation, to produce organizational outputs for release into the environment." The sections that follow explain externalization sub-activities (targeting, producing and transferring output), their execution and IT department externalization enablers.

Targeting output is the first stage of externalizing knowledge; this process is governed by the department's purpose, which lays out intended services, products and recipients. Intended direct recipients of the IT department's knowledge services include faculty, staff and students within the Mays College of Business. Indirect recipients of the IT department's knowledge services include corporate recruiters, other universities benchmarking against Texas A&M and other colleges within the Texas A&M system.

In becoming aware of recipients' needs, the IT department first communicates the department's purpose, services and knowledge. In the Mays College of Business, the IT department periodically holds training sessions for faculty, staff and students, and electronically posts updates regarding new members and their roles. Once some intended recipients are aware of the IT department as a knowledge source, socialization makes others aware of conditions where the IT department's knowledge may be helpful. Nelson and Cooprider (1996) corroborate this point. For example, at times a person responsible for IT within a department will encounter situations that cannot be solved internally; when this person inquires about how to solve the problem, they may be directed to the IT department.

Once target recipients are aware of the IT department's purpose, services and knowledge, recipients will make the IT department aware of their needs both directly and indirectly. Direct awareness includes e-mail, telephone, face-to-face conversations and surveys. Indirect contact includes "grapevine" feedback. In becoming aware of external knowledge needs the IT department is responsible for providing, the IT department strives to produce output for external environment delivery. Explicit and tacit knowledge may be transferred to outside recipients. Tacit knowledge is transferred to external recipients by collaboratively troubleshooting equipment malfunctions and software idiosyncrasies. Explicit knowledge is packaged verbally in the form of conversations, meetings and training sessions. Written explicit knowledge may be transferred through Web pages, e-mail and memos.

Externalization is enabled by mechanisms like meetings, training sessions, electronic communication and "the grapevine," all of which make external recipients aware of the IT department's services and facilitate knowledge projection. In addition, efficient execution of other knowledge manipulation activities and related enablers, socialization and downtime also enable externalization. Downtime enables pondering external recipient needs and developing social relationships enabling understanding of issues and their context.

This section explained how the IT department uses knowledge manipulation activities in KM. Because knowledge influences and knowledge resources affect knowledge manipulation activities, very few KM enablers result from knowledge manipulation activities alone. Table 1 identifies the IT department's knowledge manipulation activity enablers.

Knowledge Resources

Knowledge resources are the final component of an organization's KM system (box F in Figure 1). Webster's dictionary (1993) defines a resource as "a source of revenue or wealth to a firm." Holsapple and Joshi (1998, p. 17) explain "in the conduct of KM, human resources perform knowledge manipulation activities on knowledge resources to create organizational value." This section discusses organizational and environmental knowledge resources, explaining how these resources enable KM within the IT department.

Organizational Knowledge Resources

Holsapple and Joshi (1998, p. 17) explain that an organization's knowledge resources consist of schema resources and content resources. Schema resources depend on the organization for their existence and consist of culture, infrastructure, purpose and strategy. Schema resources are the basis for attracting, organizing and deploying content resources. Content resources exist independent of the organization to which they belong and include participant knowledge and artifacts.

Schema knowledge resources. Holsapple and Joshi (1998, p. 21) explain "schema knowledge resources are interrelated and are represented or conveyed in the workings of an organization." One of the four schema resources is *purpose.* Purpose influences knowledge manipulation activity execution and knowledge resource development. "Purpose defines an organization's reason for existence" (Holsapple & Joshi, 1998, p. 22). The purpose of Texas A&M University's Mays College of Business' IT department is supporting the college's ambition of being a world leader in the application of IT to educational processes. Purpose impacts KM execution, governing the type of knowledge needs that will initiate KM episodes and determining external recipients of the department's knowledge. The IT department's purpose enables continuous execution of KM episodes since being a world leader is a "moving target."

Purpose drives strategy. Strategy defines "activities undertaken to effectively achieve purpose" (Holsapple & Joshi, 1998, p. 23). Strategy comprises plans for using infrastructure, culture, artifacts, participant knowledge and other organizational resources in wealth creation (Holsapple & Joshi, 1998).

The sections that follow discuss the IT department's strategy, how this strategy enables KM and other strategies for improving IT department KM episodes.

Mays College of Business' Vision 2020 defines the IT department's strategy as:

> *"...maintaining state-of-the-art information technologies (teaching, research, administrative service and other) with upgrades as needed and anticipated replacement cycles of every 3 to 4 years; ensuring the Mays College of Business' IT facilities are competitive with other business schools by benchmarking the state of the college's information technologies with at least 3 other highly ranked business schools at preeminent comprehensive public universities; providing the college with trained support staff to implement/maintain information technologies; working with the library to develop holdings of business-related information resources including making these electronic resources accessible via desktops of faculty, staff and students within the Mays College of Business and within the Houston MBA program" (Strategic Planning Committee, 1998).*

This strategy governs knowledge needs that will launch KM episodes. The IT department's current strategy is embedded in a continuous learning cycle, recognizing the need for incessant deployment of KM episodes to keep pace with other universities' uses of IT and an ever-changing IT environment. The strategy addresses resource influences to support KM episodes by financially providing for training, equipment, product acquisition and maintenance.

Enhancements to the IT department's strategy further enabling KM might include explicitly recognizing the importance of managing knowledge (Pan & Scarbrough, 1999), creating artifacts (Bukowitz & Williams, 1999) and encouraging more reflection (Auer & Reponen, 1997). Recognizing the importance of managing knowledge would make the IT department more aware of preserving what the organization has learned, thus making the department less dependent on socialization and culture as a means of disseminating knowledge. One way of preserving the IT department's knowledge for the future is a strategy that encourages development of artifacts such as computerized KM systems or more documentation. If the strategy encouraged more reflection time, the IT department could devote time to analyzing KM episodes and their impact on achieving the department's mission.

Culture is also a schematic knowledge resource. Culture is defined as "a pattern of basic assumptions invented, discovered or developed by a given department as it learns to cope with its problems of external adaptation and internal integration that has worked well enough to be considered valid and therefore is to be taught to new members as the correct way to perceive, think and feel in relation to those problems" (Schein, 1990). Culture affects participant behavior in terms of how knowledge manipulation activities are performed. For example, IT department members describe their culture as team oriented, warm, supportive, friendly, non-competitive and emphasizing trust. Given this, combined with the department's feeling that their knowledge base is increasing and they are effectively managing knowledge, the IT department's culture appears to promote knowledge selection, knowledge generation and internalization. This supports Anderson and Weitz's (1992) finding that groups work better together in an atmosphere of trust based on mutual commitment and a stable long-term relationship. The department also described their culture as emphasizing learning. This environment promotes knowledge acquisition and generation as the department strives to deliver the latest advances in educational technology. The combination of a friendly culture and a culture emphasizing learning makes the department accessible and able to deliver needed knowledge to their external recipients.

Holsapple and Joshi (1998, p. 22) explain that "infrastructure is the formal counterpart to an organization's cultural knowledge resources." Holsapple and Luo (1996) explain that infrastructure consists of knowledge that structures an organization's participants in terms of roles that have been defined for participants to fill, relationships among those roles and regulations that govern the use of roles and relationships. In studying the IT department, several components of their infrastructure seem to enable KM.

The performance appraisal system enables KM within the IT department in several ways. For example, the performance appraisal system requires that specific job descriptions and responsibilities be met. Because responsibility sharing is written into job descriptions, teamwork and knowledge selection are promoted.

This finding corroborates Garvin's (2000) thoughts. In the IT department, the network administrator's job description explicitly outlines seven of eight areas where responsibilities are shared with the systems analyst. Knowledge acquisition is enabled by performance appraisal and budgeting processes. Each position's evaluation criteria outline areas where knowledge acquisition needs to occur and specify a plan for obtaining that knowledge. The budgeting/procurement process allocates financial resources for these activities. For example, one knowledge acquisition area was for the system analyst II position to learn SAP R/3; the evaluation criteria included attending SAP R/3 training. Finally, the reward system encourages teamwork because financial rewards are based on individual performance rather than mandated salary levels, force ranks and apportioned financial resources.

In the IT department, frequent socialization enables knowledge sharing. Brown and Duguid's (2000) work corroborates this point. Three of the operational IT employees share the same office, and scheduled weekly meetings promote socialization between all department members. In addition, the organizational hierarchy is flat. Having all operational IT group members at the same level leads to similar status and a noncompetitive, teamwork environment; thus promoting knowledge sharing. This makes the IT department a "knowledge community," incorporating the organizational structures (or networks) to share or pool knowledge among people with similar interests, problems and experiences.

Several researchers suggest infrastructure improvements enabling KM. The IT department may consider these in improving their KM processes. Malhotra (2000a) posited developing job descriptions and performance measurements explicitly to recognize KM as an important activity and specifying KM responsibilities within each role. Several researchers (Bukowitz & Williams, 1999; Davenport et al., 1998; Majchrzak, Rice, King, Malhotra & Ba, 2000) propose a KM position responsible for monitoring, evaluating and organizing knowledge.

Content knowledge resources. Schema knowledge resources discussed above both enable and constrain content knowledge resources (Holsapple & Joshi, 1998). Unlike schema knowledge resources, content knowledge resources exist independent of the organization to which they belong (Holsapple & Joshi, 1998, p. 17), are embodied in usable representations (Newell, 1982) and allow knowledge from the past to be brought to bear on present activities (Pan & Scarbrough, 1999). Holsapple and Joshi (1998, p. 18) explain "participant knowledge and artifacts make up the two types of content knowledge; the primary difference between the two is that participant knowledge has knowledge processing abilities and artifacts do not." The sections below explore participant knowledge and artifacts within the

IT department, including what affects their development and availability. Participant knowledge and artifacts are not discussed in Table 1. While these resources can be brought to bear in KM episodes, we did not discover any KM enablers that were unique to content knowledge resources.

"Participants have knowledge manipulation skills that allow processing of their repositories of knowledge" (Holsapple & Joshi, 1998, p. 18). Three types of participant knowledge can exist in an organization: human, computer-based and hybrid. "Human participant knowledge is knowledge that a person or collection of people are willing to manipulate or make available in the execution of the organization's knowledge manipulation activities" (Holsapple & Joshi, 1998, p. 19). Individual human knowledge within an organization consists of the knowledge embedded in each role and within each person in a role. IT department roles include: associate dean, network administrator, systems analyst I, systems analyst II, facilities officer and student workers. In addition, human social knowledge is embedded within the entire IT department and the college of business.

"Computer-based participant knowledge is knowledge stored in a computer system that can perform one or more of the knowledge manipulation activities" (Holsapple & Joshi, 1998, p. 19). Unfortunately, computer-based participant knowledge such as an expert system or decision support system does not currently exist within the IT department. However, hybrid participant knowledge, which is "knowledge made available or used by joint human-computer entities" (Holsapple & Joshi, 1998, p. 20), does exist. The IT department's electronic communication system assists the department with internalizing and externalizing knowledge.

The extent participant knowledge is made available in KM episodes is the result of managerial influences on schematic resources. For example, because management has helped design an infrastructure creating a culture emphasizing teamwork and socialization, participants willingly bring their knowledge to bear in KM episodes, thus increasing organizational knowledge. Unfortunately, because knowledge is easily selected from other members, knowledge artifacts and computerized participant knowledge are not well developed. This lack of explicit knowledge artifacts contrasts with Schultze's (2000) research where systems administrators kept extensive artifacts documenting their thoughts and actions because the culture was unfriendly.

The main difference between an artifact and participant knowledge is "an artifact is not accompanied by a processor and does not depend on a participant for its existence; artifacts merely convey or hold usable representations of knowledge" (Holsapple & Joshi, 1998, pp. 18-20). Like participant knowledge, artifact development and availability is mostly attributed to management influences on schema resources. For example, within the IT department management does not emphasize artifact creation; therefore, schema resources like strategy do not encourage significant artifact development. Without a mechanism for preserving knowledge in artifacts, knowledge resources will decrease, particularly when core and ancillary participants leave the organization (Senge, 1990). Some artifacts do exist within the IT department, including artifacts developed inside and outside the department. These include file folders conveying information on new technology evaluation, equipment maintenance records, classroom equipment use presentations, contact lists, equipment check-out procedures, calendars and timesheets. The department's computers also contain artifacts such as user accounts, inventory, Web page ownership and archived e-mail. Other artifacts in the IT department include explicit conveyances of schematic knowledge resources such as organization charts, mission statements, vision statements and job descriptions. Outside participants also create IT department artifacts, including vendor equipment and software manuals, license agreements, billing statements, warranties and training manuals.

Environmental Knowledge Resources

Even though environmental knowledge resources may differ between organizations, between levels within an organization and between participants within organizational levels, an organization's environment is a knowledge resource. In general, executive-level environmental resources will be more general and less technical than operational-level environmental resources. The combination of a role's responsibility (e.g., network administrator) and an actor's interest (a person filling a role) influence the type of environmental resources an actor acquires. Determining environmental knowledge resources of actors formerly filling organization positions may assist incumbents in acquiring information.

CONCLUSION

Our study explores how KM occurs within a specific IT department. While we set out to study both organizational and technical dimensions of KM, this study showed the importance of people in KM and thus the human-centric approach in KM execution. We found the IT department did engage in technical aspects of KM. However, the information processing view, and supporting information and communication technologies, played a minor role in the department's KM process. The organizational dimension was more critical to actual KM. Walsham's (2001) and Gold, Malhotra and Segars' (2001) studies support our finding. From a practical viewpoint, the study underscores the necessity of understanding and supporting the human element of KM over the technical element that is so often more heavily touted in vendor solutions and the trade press.

Social aspects of KM manifest in many ways. Adequate employee retention policies are required to prevent loss of intellectual capital embedded in employees' knowledge. The quality of knowledge work is often enhanced by personal feedback from users. Encouragement in areas of experimentation is often beneficial in creating an environment conducive to knowledge creation. Knowledge selection activities often involve approaching other knowledge workers first. This is because when co-workers have solutions to knowledge problems, accessing that knowledge on a person-to-person basis is often faster and the knowledge is communicated in a much richer manner than when one must resort to non-human knowledge-containing artifacts. Knowledge sharing activities include conversations, meetings and formal and informal communications (which may include e-mail). Users of the outputs of knowledge workers use social activities such as meetings and e-mail to communicate their needs. These social activities also facilitate knowledge externalization to users. In short, attention to social factors in the knowledge workplace impacts all phases of KM. And the most essential of these social aspects, leadership, may be much more critical to creating an effective KM environment than technology used to support that environment.

Our study has three theoretical implications. First, this study validates and expands Holsapple and Joshi's 1998 KM framework by showing the conduct of KM within a particular IT department and follows their model up to a point. That point occurs where KM culminates in achievement of learning and projection (Figure 1). Whereas Holsapple and Joshi showed learning and projection occur in parallel, our study indicates learning occurs before projection. Therefore, the two steps occur in sequence. Second, we developed a model detailing the sequence in which knowledge manipulation activities occur (Figure 2). Our model shows circumstances triggering knowledge manipulation activities and interrelations of knowledge manipulation activities. Third, we developed a model outlining enablers of KM within the IT department (Table 1). This model suggests cooperative learning theory (Janz, 1999, p. 173) can be leveraged in explaining KM enablers.

Even though the IT department in our study does not intentionally pursue KM with a KM strategy, the department did engage in KM episodes, and enablers of KM were present in knowledge influences, knowledge manipulation activities and schema resources. These findings corroborate several studies (Cook & Brown, 1999; Hutchins, 1990; Lave, 1988; Orlikowski, 2002), stressing the importance of "knowing in practice." In the spirit of Newell and Simon's (1976) exposition regarding computer science as empirical inquiry, this study adds a data point to the accumulating knowledge of KM.

Our study addresses two KM research agendas. Using a celled, three-dimensional process framework for KM, Grover and Davenport (2001) called for researching the impacts of an organization's strategy, structure, culture and technology on stages of knowledge processes at individual, group and organizational levels. Our study takes a group scope, focusing on multiple cells in Grover and Davenport's framework. Suggesting KM research areas, Earl (2001) identified seven schools for KM research and practice: systems, cartographic, engineering, commercial, organizational, spatial and strategic. Our findings address organizational perspectives with a human community focus.

Earl (2001) noted organizations are striving to establish intraorganizational or interorganizational knowledge communities for better knowledge sharing. From a practical standpoint, organizations should consider incorporating our proposed KM enablers into the design of IT work structures as a means of improving KM processes, creating an organizational environment more supportive of KM. Our study exposed the integral nature of teamwork and social interactions in all areas of KM. Our findings corroborate Hollingshead's (1998) exposition: "…knowing what other group members know can increase each member's access to information and can have a direct impact on the quality of members' work and group decisions." Most importantly, organizations must recognize and support the social aspect of KM. Organizations that focus solely on technical support for KM will find efforts falling far short of expectations.

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Chapter V

E-mail's Value: Internal versus External Usage

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ABSTRACT

This chapter provides a new perspective on the competitive advantage of electronic mail within organizations. Essentially, e-mail assists individuals with efficiency and effectiveness. It improves the overall productivity of the firm and provides better coordination of internal processes. Electronic mail has been considered an important channel of communication. Since quality, time and cost are considered the main means of competition in today's global market, this study investigated the relationship between the strategic uses *and competitive benefits of electronic mail in contemporary organizations. A sample of 99 management-level staff members in 41 companies responded to a questionnaire assessing their e-mail usage and their perceived e-mail benefits. The results suggested that e-mail usage could augment the competitive posture of the firm.*

INTRODUCTION

"E-mail [electronic mail] correspondence is the fastest growing communication medium in the world. In 2000, more than 7 trillion e-mail messages traveled the wires in the U.S. alone, up from a mere 4 trillion in 1999. Additionally, the most recent findings report that the average businessperson sends and receives a total of about 90 e-mail messages daily" (Casperson, 2002, p. 10). Information technology (IT) investments are in excess of 50% of capital budget expenditures in United States (U.S.) organizations (Rockart, Earl & Ross, 1996). Managers and researchers agree that IT must be appropriately utilized by individual users within these organizations in order to achieve increased worker productivity, better decision making or other expected benefits (Srinivasan, 1985). Thus, researchers continue to develop new theories in an effort to inform IS professionals who design and manage information technology that support managerial communication (Ngwenyama & Lee, 1997).

The success of an organization depends on rapid, reliable and direct communications within the organization and with the outside world. To determine if e-mail provides a competitive benefit, a sample of 99 management-level participants in 41 companies responded to a survey that assessed their intraorganizational (internal) and interorganizational (external) uses of e-mail. Through the use of factor analysis and regression methodologies, the researchers investigated whether a significant relationship exists between the internal and external uses and benefits of e-mail. The intraorganizational uses of e-mail indicated a significant and positive relationship with the organizational benefits of e-mail, thus, supporting the electronic exchange of information within organizations. However, the results indicated that interorganizational uses of e-mail did not promote corporate communication outside the company. Thus, managers need to know which communication technology is appropriate for intraorganizational and interorganizational uses.

Research into the uses and benefits of e-mail has become important to understand this growing phenomenon (Rudy, 1996). The results of this study provide important implications for managers in suggesting appropriate use of communication technology in order to improve the organizational benefits.

BACKGROUND

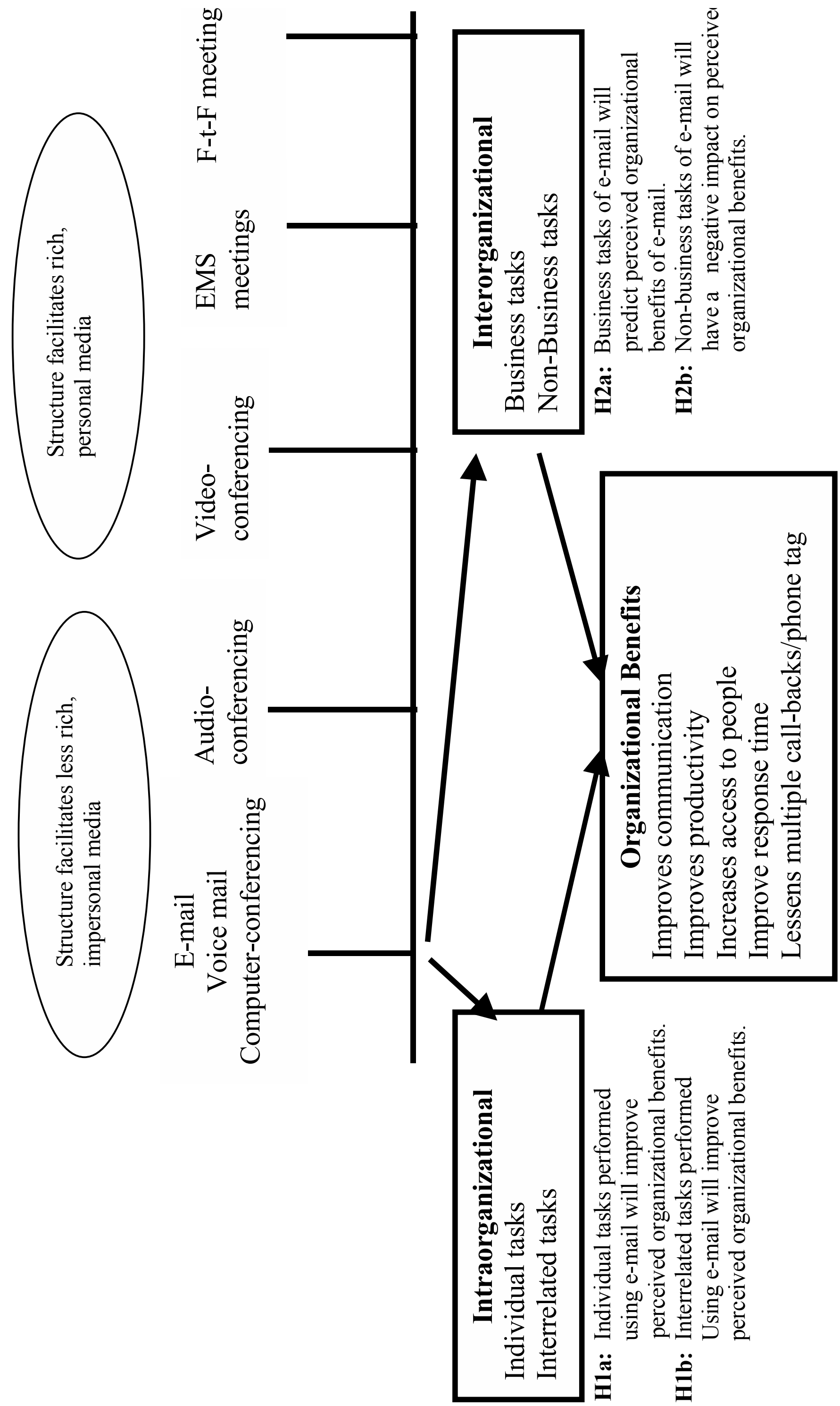
Communication is critical in organizations. Researchers have noted that communications can be considered the lifeblood of an organization, and as the world in which an organization exists becomes ever more fast-paced, communication becomes even more essential (Chidambaram & Jones, 1993). "E-mail has become as indispensable a business tool as the telephone, the postal service or the fax machine" (Harper, 2002, p. 56). Electronic mail has proven to be one of the primary technologies by which an organization can begin to achieve radical and beneficial organizational change (Carroll, 1993; Fortune, 1999). Since it offers many advantages to today's businesses, e-mail continues to be an important topic for business research (Reark, 1989; Rudy, 1996, 1994). E-mail, as a specific informational technology (IT), has become an integral part of the corporate culture in many organizations (Carroll, 1993; Fortune, 1999). This corporate culture fosters the intraorganizational (internal) uses and interorganizational (external) uses of e-mail, with expectations of organizational benefits as a result.

"Building an e-mail database should be central and basic to businesses because this means of communication is both extremely effective and very economical" (American Gas, 2002, p. 10). Over the past five years, e-mail has changed the way business is done (Fusaro, 1998; Garai & Pravda, 1995) and it has become indispensable to many business professionals (Trumfio, 1994). As e-mail use has escalated, its strategic importance has begun to emerge. However, as illustrated in Figure 1, companies can use a variety of communication media (e.g., e-mail, audio conferencing, videoconferencing) to conduct business transactions. Managers need to know which communication technology in the continuum (see Figure 1) is appropriate for intraorganizational and interorganizational uses.

Previous researchers in computer-mediated-communication (CMC) have studied various behavioral and technical issues related to traditional modes of communication (Chapanis, Ochsman, Parrish & Weeks, 1972; Rice, 1994). They have studied how media differ in their potential for communicating understanding by individuals (Allen & Griffeth, 1997). While the predominant mode of communication among organizational groups has been face-to-face meetings, technological advances have permitted many firms to explore other modes of communication, such as videoconferencing, audio-conferencing and electronic mail. Although these technologies overcome the constraints of time and distance, they are lower in information richness, interactivity and human contact.

Chidambaram and Jones (1993) used the framework of communication media, illustrated in Figure 1, to present the richness of any medium as fixed in the overall richness scale, without regard to differences in the individuals using the

Figure 1: Communication Richness Model and Research Model



medium. Markus (1994) conducted a field study that provided quantitative and qualitative evidence that the "actual media use behavior of managers was inconsistent with the information richness theory. In particular, managers, especially senior managers, used the [electronic mail] medium more intensively than the [information richness] theory predicts and in a manner that the theory regards as ineffective and hence unlikely" (Markus, 1994, p. 518). Lee (1994) has also presented evidence of how managerial communication using e-mail was still capable of being rich, despite the fact that e-mail has all the lean media characteristics that the information richness theory predicts would lead to lean communication. Furthermore, El-Shinnawy and Markus (1992) found empirical evidence that individuals preferred e-mail.

From a pragmatic point of view, the communications technology that is chosen will be a compromise between what is available, the amount of time available to perform the task, the complexity involved and the cost. As illustrated in Figure 1, videoconferencing has greater richness, however, it is more expensive and complex. Thus, e-mail has surfaced and become widespread because of its simplicity and low cost.

Organizational Benefits of E-Mail

Furthermore, Kettinger, Grover and Segars (1995) suggested that reducing customer uncertainty was one of the factors leading to the strategic use of IT. The effective utilization of e-mail to expedite projects provided a competitive advantage by delivering better and faster services and products to the customer. Thus, e-mail can improve a firm's competitive position by increasing productivity and enhancing communication inside and outside the organization.

Research has indicated that organizations have benefited from the use of e-mail with improved productivity (Curley, 1984; Edelmann, 1981; Sharda, Barr & McDonnell, 1988), improved response time, improved communication and better decision making, (Zienert, 1995). Culturally, e-mail has the potential to change organization norms and communication relationships (Kettinger, 1992).

Intraorganizational Uses of E-Mail

There are more than 82 million e-mail accounts in the U.S., according to the research firm International Data Corporation in Framingham, Massachusetts (Fortune, 1999).

E-mail is considered the electronic transmission of messages, documents, data, images or any combination of these. Since it has offered many advantages to today's businesses, e-mail has continued to be an important topic for business research (Reark, 1989; Rudy, 1994, 1996).

The use of e-mail has been considered a component of overall business strategy, and its application depends more on understanding unique business opportunities than on organizational benefits from technological features that are easily duplicated. The notion of strategic integration and communication of information systems with the production, marketing, financial and other functional systems in the organization may have influenced technology selection and the strategic direction in some firms.

As new technologies that support managerial communication become widely used, the question of how and why managers, especially senior managers, use them increases in importance (Markus, 1994). Researchers who have studied e-mail usage within organizations suggested that it alters the dynamics of work, changes tasks and has important social implications (Culnan & Markus, 1987; Hiltz & Johnson, 1990; Rudy, 1996; Steinfield, 1986). The increasing ubiquity of e-mail lessened telephone tag and made direct communication more efficient, even when there were no other sophisticated systems support (King & Tea, 1994).

E-mail usage has received the most attention in terms of its potential for improving productivity of office information workers (Sharda, Barr & McDonnell, 1988). Thus, intraorganizational uses of e-mail include two factors: individual tasks and interrelated tasks. Individual tasks represented the use of e-mail to increase the speed, efficiency and effectiveness of communication (Zienert, 1995). The utilization of e-mail for these tasks improved the productivity of individuals, giving them the ability to concentrate on more critical tasks.

Interrelated tasks use e-mail to accomplish tasks or to achieve communications that typically involve multiple departments or divisions (Zienert, 1995). Thus, the following hypotheses were proposed:

Hypothesis 1: Intraorganizational uses of e-mail will predict the perceived organizational benefits of e-mail.

H1a: Individual tasks performed using e-mail will improve perceived organizational benefits.

H1b: Interrelated tasks performed using e-mail will improve perceived organizational benefits.

Interorganizational Uses of E-Mail

E-mail has enabled people to send messages to others with e-mail addresses anywhere in the world, and is fast, inexpensive and easy to use, making it a convenient and flexible way to improve corporate communications (Zienert, 1995). Although computer and telecommunications equipment have been used extensively in modern firms, these technologies are not new. Their widespread adoption and continued application in business have established computers as crucial vehicles for organizational effectiveness. The impact of IT has been pervasive, reaching into the decision-making processes in both small and large organizations. E-mail, as an IT capability, has been used to change a product, differentiate a product, open new markets electronically and create barriers to entry by competitors (Parker, 1998; Stephens & Loughman, 1994).

The utilization of e-mail to communicate with customers and suppliers indicates the need for interorganizational linkages. These interorganizational uses can be defined as business tasks and non-business tasks. In Edwards' (1998) study, many customers required the ability to communicate with key people in a firm through the use of e-mail, which gave them a sense of personalized service that allowed direct access to a person who could answer their questions and solve their problems. Providing this dependable link to the customer can give a company an edge over its biggest competitors (Edwards, 1998).

The use of e-mail for purposes unrelated to the business or to an individual's work was considered a non-business task. The use of e-mail by individuals to socialize or to entertain themselves represented a personal use of a corporate resource. Previously, non-business uses of e-mail have negatively impacted the organization. These findings have been supported in other studies which refer to such applications as "inappropriate use" of e-mail technology (Rice, 1994). Thus, these arguments suggested the following:

Hypothesis 2: Interorganizational uses of e-mail will predict perceived organizational benefits of e-mail.

H2a: Business task uses of e-mail will predict perceived organizational benefits of e-mail.

H2b: Non-business task uses of e-mail will have a negative impact on perceived organizational benefits.

METHODOLOGY

During the first quarter of 1999, 250 questionnaires were mailed to participants in 41 companies located primarily in the Southeastern United States. Completed questionnaires were received from 99 individuals, representing a 40% response rate. Of the 99 participants, 65% were classified as management level, 58% used e-mail for more than five years and 53% used e-mail 10 to 30 times per day. The respondents represented a cross-section of industries, with four industries representing 68% of the sample and 59% exceeding $1 billion in sales. The characteristics of the companies in the sample are illustrated in Table 1.

Table 1: Characteristics of the Companies in the Sample

Type of Industry	Percentage of Companies
Manufacturing	19.5
Electronics, Computer Systems	9.8
Telecommunications	12.1
Retail Sales	9.8
Electric or Gas Utility	14.6
Financial Services	17.1
Professional Services/Consulting	17.1
Total	100.0

Company Size (1999 Sales)	Percentage of Companies
Less than $500 million	21.9
$500 million to under $1 billion	19.6
$1 billion to under $5 billion	31.7
Over $5 billion	26.8
Total	100.0

Measures

The survey instrument was used to collect general demographic information. The questionnaire assessed an individual's uses and perceived benefits of electronic mail. Respondents were asked, unless otherwise stated, to indicate their level of agreement with each item on a seven-point Likert-type scale, with higher values indicating greater levels of agreement (e.g., never = 1; always = 7).

The number of years the respondent had been with the company and gender were assessed using single-item measures. Level in the company, age and education level were assessed using objective multiple-choice questions. The items were scored by assigning a numeric value to each possible answer (e.g., executive level = 1; other = 6).

ANALYSIS

To determine the underlying composite factors, a confirmatory factor analysis was conducted. The e-mail usage factors that were developed in the Zienert study (1995) using a Varimax rotation factor analysis were confirmed. This resulted in four distinct factors emerging from the usage items. The uses factors included *intraorganizational uses* (e.g., *individual tasks* and *interrelated tasks)*, and *interorganizational uses* (e.g., *business tasks* and *non-business tasks)*. All of the factors showed reasonable internal consistency (alpha > .70).

The benefit composite factors were developed using a Varimax rotation factor analysis. The benefit factor selected for this research was the *organizational benefits* of e-mail, which included 10 of the benefit items. The benefit factor showed reasonable internal consistency (alpha > .80).

Intraorganizational uses of e-mail were assessed by using the composite factors, *individual tasks* and *interrelated tasks*. The *individual tasks* of e-mail were assessed using five items from the e-mail instrument, as displayed in Table 2. This subscale (alpha = .70) measured the extent to which participants were using e-mail to measure variables that allow users to accomplish job-related tasks more efficiently and effectively, thus making them more productive. *Interrelated tasks* of e-mail were assessed using six items from the instrument, as displayed in Table 2. This subscale (alpha = .80) measured the extent to which participants were using e-mail to share tasks and information between divisions or departments in the firm.

Interorganizational uses of e-mail were assessed using the composite factors, *business tasks* and *non-businesses tasks*. The *business tasks* were assessed using six items from the e-mail instrument, as displayed in Table 2. This subscale (alpha = .80) measured the extent to which participants were using e-mail to communicate with the firm's strategic partners, namely customers and suppliers. *The non-business tasks* of e-mail were assessed using two items from the instrument, as displayed in Table 2. This subscale (alpha = .74) measured the extent to which participants were using e-mail for social, personal interaction or non-business tasks.

Organizational benefits of e-mail were assessed using a composite factor, which contained 10 items from the instrument, as displayed in Table 2. This subscale (alpha = .90) measured the extent to which participants benefited from the use of e-mail. These items demonstrated that e-mail assisted in performing work better and communicating better, thus improving the firm's overall performance, and conceivably, its position in the industry.

RESULTS

Descriptive statistics, alpha reliability coefficients and correlations among the variables are presented in Table 3. Relationships among the variables appeared as expected, participant's self-reported e-mail usage per day was positively correlated with e-mail experience ($r = .39$, $p < .05$). Although significant, the correlations

Table 2: Factor Analysis Solution

FACTOR (Independent Variables) - Questionnaire Item	**Alpha**
FTA1: INDIVIDUAL TASKS	.70
Distribute/provide information	
Schedule meetings/appointments	
Send messages instead of placing phone calls	
Send/receive instructions concerning files or programs	
Learn about events and items of interest	
FTA2: INTERRELATED TASKS	.80
Give and receive feedback on reports and ideas	
Coordinate and monitor projects	
Resolve conflicts/disagreements	
Coordinate groups	
Poll opinions on a topic	
FTA3: BUSINESS TASKS	.80
Contact suppliers	
Contact sales force	
Make a product/service	
Contact customers	
Order stock	
Solicit business	
FTA4: NON-BUSINESS TASKS	.74
Organize social activities	
Participate in entertaining events or conversations	
FTA5: ORGANIZATIONAL BENEFITS OF E-MAIL	.90
Improves communication	
Improves productivity	
Increases access to people	
Improves response time	
Lessens multiple call-back/phone tag	
Improves decision-making	
Improves communications between decision-makers	
Facilitates direct communication	
Expedites projects	
Increases document turnaround	

Table 3: Descriptive Statistics and Correlations Among Study Variables[a,b]

Study Variables	M	SD	1	2	3	4	5	6	7	8	9	10
Demographics												
1. Level in company	3.09	1.49	--									
2. Age	2.36	1.08	-.33	--								
3. Gender[c]	1.69	0.47	-.25	.07	--							
4. Education level	3.21	0.81	-.41	.12	.21	--						
E-mail Experience and Usage												
5. E-mail experience	4.42	0.76	-.18	.22	.28	.22	--					
6. E-mail usage/day	3.47	0.84	-.09	.06	-.03	.05	.39	--				
Intraorganizational Uses												
7. Individual tasks	5.33	0.72	.09	-.17	.05	.07	.18	.21	--			
8. Interrelated tasks	4.53	0.97	-.09	-.04	.03	.12	.26	.26	.74	--		
Interorganizational Uses												
9. Business tasks	2.60	1.23	-.15	- .05	.02	.13	.19	.29	.27	.29	--	
10. Non-business tasks	2.94	1.42	.00	-.31	-.02	.09	.02	.11	.44	.33	.39	--
E-Mail Benefits												
11. Organizational benefits	5.36	0.97	-.00	.04	-.07	-.10	-.02	.10	.66	.61	.19	.32

[a]*N = 99; reliabilities could not be computed for single–item measures.*
[b]*All correlations greater than or equal to .20 significant, $p < .05$, two tail.*
[c]*Gender was coded 1 = females, 2 = males.*

between age, gender and e-mail experience were lower, ranging from .22 to .28. Generally, respondents who claimed higher e-mail usage per day were in higher levels of management and had more years of e-mail experience.

The purpose of the study was to assess the relationship between the hypothesized predictor variables and e-mail benefits. The dependent variable, *organizational benefits,* was significantly and positively related to *intraorganizational uses* and *interorganizational uses* of e-mail. Contrary to expectations, the dependent variable was not significantly correlated with level in the company, age, education level, e-mail experience and e-mail usage per day. Individual tasks had the highest correlation with organizational benefits ($r = .66, p < .05$).

The pattern of relationships was less systematic between the predictors and the demographics. E-mail usage per day was positively correlated with individual tasks ($r = .21, p < .05$), and interrelated tasks were positively correlated with e-mail experience ($r = .26, p < .05$) and e-mail usage per day ($r = .26, p < .05$). In addition, correlations among the independent variables had a mean value of .35 and a maximum value of .74, with a maximum variance-inflation factor less than 2.6 and a mean variance-inflation factor less than 1.6; therefore, multicollinearity was not a severe problem that would preclude interpretation of the regression analysis (Neter,

Table 4: Regression of Benefits on Organizational Uses of E-mail

Independent Variables	Standardize Beta Coefficients
Intraorganizational Uses	
Individual Tasks	beta ***
Interrelated Tasks	beta *
Interorganizational Uses	
Business Tasks	Beta
Non-Business Tasks	Beta
Adj $\underline{R}^2$	.57
F-ratio	**
$\underline{N}^a$	99

[a]N = Number of respondents
** p < .05; ** p < .01; *** p < .001*

Kutner, Nachtsheim & Wasserman, 1996). Therefore, multiple regression analysis was used to examine the combined contributions of the demographic and e-mail uses in predicting organizational benefits of e-mail. The overall model was significant ($R^2 = .57$, $p < .01$). The results and hypothesis testing are shown in Table 4.

Intraorganizational uses of e-mail emerged as a significant positive predictor for perceived organizational benefits. The results of the analysis and hypothesis testing are shown in Table 4. H1a, *individual tasks* performed using e-mail will improve perceived organizational benefits ($p < .01$), and H1b, *interrelated tasks* performed using e-mail will improve perceived organizational benefits, were supported.

Interorganizational uses of e-mail. The results of the multiple regression analysis did not find significant evidence to support Hypothesis 2 (interorganizational uses of e-mail will predict organizational benefits of e-mail). The results of the analysis and hypothesis testing are shown in Table 4. H2a, business tasks of e-mail will predict organizational benefits, was not supported ($p > .01$). H2b, *non-business tasks versus business tasks of e-mail* will have a negative impact on organizational benefits, was not supported ($p > .01$).

DISCUSSION

The study explored the relationship between e-mail uses and organizational benefits of e-mail. Overall, there was evidence of a relationship between the organizations level of e-mail usage and organizational benefits of e-mail. The intraorganizational uses of e-mail indicated a significant and positive relationship with the organizational benefits of e-mail. On the other hand, external use, interorganizational, of e-mail was not supported by the study.

The variable tested in H1a, *individual tasks,* allowed users to accomplish job-related tasks more efficiently and effectively, thus improving productivity. As stated in literature, e-mail is an example of an information technology that has potential as a strategic tool (Bodamer, 1999; Carroll, 1993; Wiesendanger, 1993) because of its capacity to increase efficiency, to decrease costs and to improve productivity. These respondents indicated that they used e-mail to achieve improvements in efficiency, effectiveness and business transformations, which ultimately increased their productivity.

The variable tested in H1b, *interrelated tasks,* allowed users to share tasks and information between divisions or departments in a firm. E-mail provided a method of communication that influences the company's strategy, which included sharing tasks and coordinating efforts across functional areas, avoiding duplication and guaranteeing that critical tasks are completed in a timely manner.

On the other hand, the variable tested in H2, interorganizational uses, did not contribute a significant amount of unique variance toward the prediction of organizational benefits. *Business tasks* represented the communication between the firm's strategic partners. Although electronic communication between strategic partners is commonly cited as an important competitive use of e-mail (Dietrich, 1995; Seideman, 1995), this study did not find evidence to support the hypothesized relationship between *business tasks* (H2a) and *organizational benefits*.

However, there are many interorganizational systems, such as Electronic Data Interchange (EDI) and Electronic File Transfer (EFT), that are used throughout industry to conduct business with strategic partners and customers. This type of medium is highly structured, as illustrated in Figure 2, because it follows a protocol to achieve the equivalent of a written format. Additionally, these types of communication are low in richness, because each performs specific programmed tasks. These are business tasks that are widely used and accepted by industry as interorganizational uses of communication media. Although an e-mail message may contain all the required information, it does not follow a standard protocol. This lack of structure and protocol may be acceptable and understandable by the internal culture of the organization; however, it does not transmit effectively across external organizational boundaries. Therefore, one explanation of why organizations prefer e-mail for internal communication but not external communication is because e-mail is low in structure and richness, as illustrated in Figure 2. The illustration combines the communication model and the results of this research model. Additionally, structured versus unstructured communications media and low richness versus high richness are indicated in the illustration. Organizations must select specific media for specific tasks based on the level of structure and richness for business tasks.

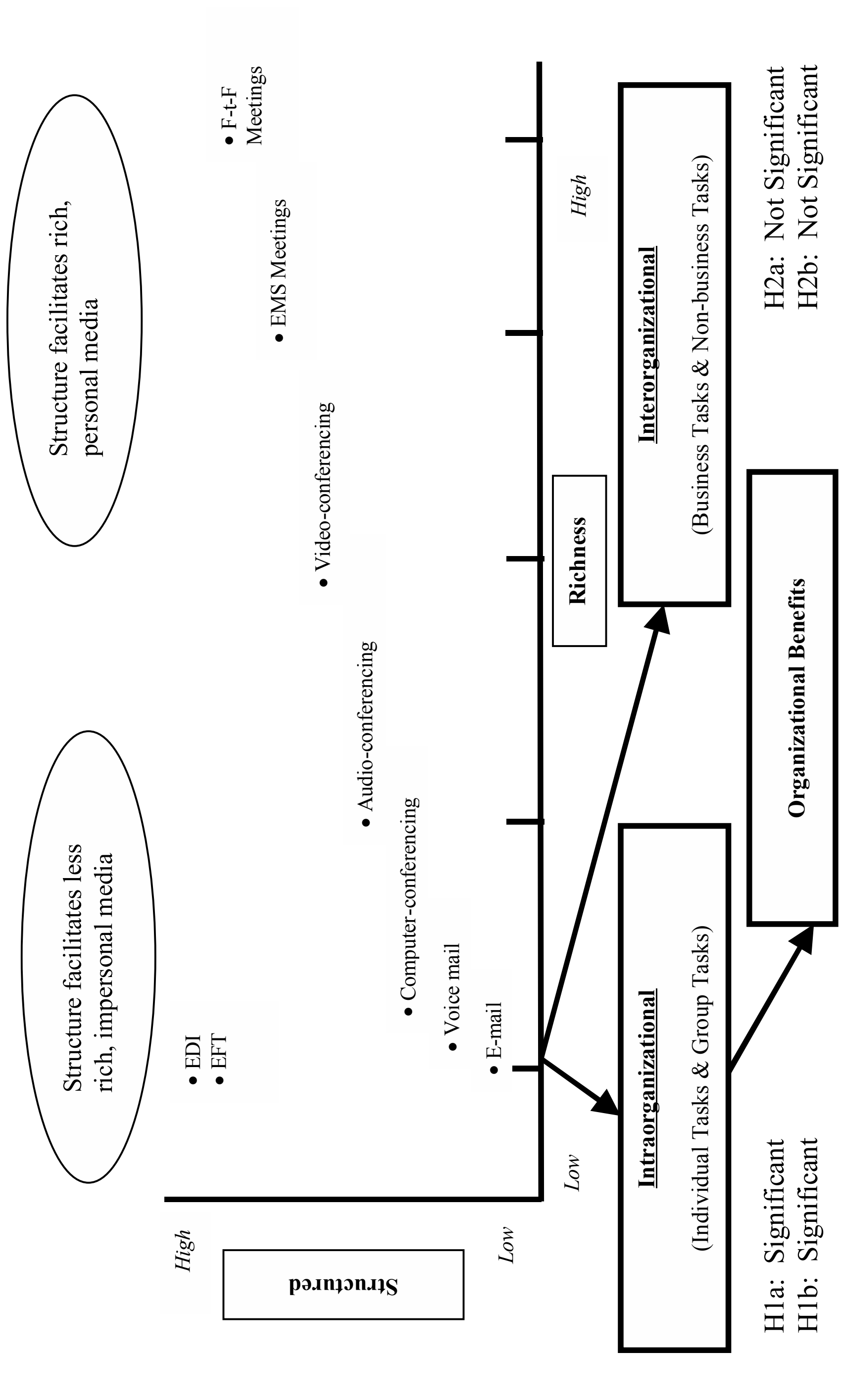
Furthermore, H2b, *non-business tasks of e-mail* will have a negative impact on organizational benefits, was not supported. The belief was that if employees are utilizing time for social activities, the company is not achieving its business goals. Therefore, the misuse of e-mail for non-business activities had the potential to negatively impact the competitive performance of the company. This, however, was not supported.

The overall assessment of the findings indicates that intraorganizational benefits of e-mail constitute an increase in work communication and work performance, which improves the firm's overall performance. However, interorganizational uses of e-mail did not promote corporate communication outside the company.

Recommendations for CEOs/CIOs

The implications of this study are noteworthy for today's organizations. Results indicated that intraorganizational uses promoted corporate communication. Com-

Figure 2: Research Model Relationship to Structured and Unstructured Communication Model



munication is a chief concern for IS executives (Bodamer, 1999; Stephens & Loughman, 1994), and e-mail is one of the technologies that facilitates and improves corporate communication. Successfully using IT for a competitive advantage does not rely on technological advances as much as on effective identification and exploitation of IT-based opportunities. E-mail, as one such technology, plays a vital role in consolidating disparate interests in the firm by bringing together departments and divisions that may not have coordinated their efforts in the past. This study can support the recommendations of CEOs and CIOs to utilize electronic communication within the organization and utilize other methods of communication for external communication.

Previous research has indicated that the importance of using the power of IT to build a sustainable competitive advantage (McRary, 1995) was achieved by leveraging unique corporate abilities with IT to achieve long-term performance gains (Kettinger, Grover, Guha & Seagers, 1994). Thus, properly implementing intraorganizational e-mail systems to support the electronic exchange of information within organizations can contribute to competitive advantage through cost and time efficiencies.

FUTURE TRENDS

Literature has suggested that the ability to communicate between customers and strategic partners is important. As companies continue to strive for an effective and efficient global market, it would stand to reason that interorganizational business use of e-mail would be important. Not only uses of e-mail, but also other non-face-to-face communications techniques have evolved at different rates in various regions, cultures and nations around the world. Therefore, this model can be used for other organizations worldwide that require the use of this technology. Additionally, future trends would include an examination of the extent that e-mail satisfies a basic need, e.g., not only that e-mail reduces paper costs but also to what extent is e-mail actually used to reduce paper costs.

E-mail is becoming as common as regular postal mail in the twentieth century. In many cases, it has replaced domestic and international postal mail. Schools and universities are insisting that all students have an e-mail account and students log in every day in order to obtain information. Employees in companies are forced to log in at least once if not more times during the day. PDAs and other portable devices provide access to e-mail even when an employee is on the road. Given the widespread acceptance and use of this technology, this study adds value by showing the strategic value of e-mail to an organization.

More companies have found strategic and creative ways to use e-mail, making it an important technology for today's businesses. Companies are finding ways to build more functionality into their core mail systems. Clearly the definition and parameters around e-mail are changing and the use of e-mail is revolutionizing how firms do business. Therefore, companies must continue to find innovative ways to use e-mail. This study and others like it may allow managers to evaluate e-mail issues that will positively and negatively affect their organization. Thus, managers may be able to use the results of this research to change, improve or implement their e-mail systems with a strategic emphasis.

CONCLUSION

IT, such as e-mail, has played an important role in extending the enterprise beyond traditional organizational boundaries. Intraorganizational systems have incorporated traditional information system elements that permit shared applications by linking organizations electronically. Computer and communications technologies are expected to play a major role in the changing marketplace (Kirschner, 1995). This research indicated that e-mail is a vital part of everyday intraorganizational communication between departments and divisions. On the other hand, the interorganizational use of e-mail did not provide the same level of organizational benefits. Therefore, managers must ask if face-to-face communications is still the preferred mode of communication for interorganizational coordination, in light of the existence of the available information technologies.

As Davis' (1989) vision of firms providing their products at "any time and any place" becomes a reality, a new means of delivering services, effective communication channels and improved methods of coordination will form the foundation for remaining globally competitive. As the results of this study suggested, technologies such as e-mail can assist in providing such a foundation for organizations.

The results indicated that e-mail is a vital part of everyday communications within and between organizational departments and divisions. As the millennium continues to thrive, managers must ask if face-to-face communication is still the preferred mode of communication or have other modes become just as rich and more efficient. E-mail, audioconferencing, videoconferencing and EMS meetings are changing the way organizations conduct business. Researchers and managers must continue to study and view established technologies, such as e-mail, in a more strategic perspective to gain a competitive advantage.

This research challenges many of the assumptions of this evolving electronic age. Companies and individuals are making the assumption that all communication activities between organizations, customers, suppliers and strategic partners can be conducted electronically, with no human-to-human interaction. This is the model in which electronic commerce is being built to support the corporate community. This study supports electronic communication within the organization, but indicates limitations with communication outside the organization. The electronic age is inevitable, the effective use of electronic communication is a necessity and the strategic implementation of electronic capabilities will determine the future success of the corporation.

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Chapter VI

The Value of Managerial Flexibility in Strategic IT Investment: Identify the Real Options of Resource Allocation

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ABSTRACT

In this chapter, we discuss the real options theory and its applications in IT investment evaluation. We provide a framework within which the appropriateness of using real options theory in strategic IT investment evaluation is systematically justified. In our framework, IT investment opportunities are classified into four categories based on two criteria: the technology switching costs and the nature of competition. We point out that different real options models should be adopted for each category. The

electronic brokerage's investment decision in wireless technology is discussed as a real-world case within the framework. Our study also provides some insights about the relationship between technology standardization and IT investment decisions.

INTRODUCTION

Many information resource managers have learned to be proactive in today's highly competitive business environment. However, limited financial resources and many uncertainties require them to maximize their shareholders' equity while controlling the risks incurred at an acceptable level. As the unprecedented development in information technology continuously produces great opportunities that are usually associated with significant uncertainties, technology adoption and planning become more and more crucial to companies in the information era. Karahama et al. (1999) point out that the value-adding potential of the new technology in question is a critical factor in IT adoption. Raghunathan and Madey (1999) develop a firm-level framework for electronic commerce information systems (ECIS) infrastructure planning.

In this study, we attempt to evaluate IT investment opportunities from a new perspective, namely, the real options theory. Unlike the standard corporate resource allocation approaches, the real options approach acknowledges the importance of managerial flexibility and strategic adaptability. Its advantage over other capital budgeting methods like static discounted cash flow analysis has been widely recognized in analyzing the strategic investment decision under uncertainties (Amram & Kulatilaka, 1999; Luehrman 1998a, 1998b). Smith and McCardle (1998, 1999) further show that an option pricing approach can be integrated into a standard decision analysis framework to get the best of the both worlds. In fact, some previous IS researches have recognized the fact that many IT investment projects in the uncertain world possess some option-like characteristics (Clemsons, 1991; Dos Santos, 1991; Kumar 1996). Recently, Benaroth and Kauffman (1999, 2000) and Taudes, Feurstein and Mild (2000) applied the real options theory to real-world business cases and evaluated this approach's merits as a tool for IT investment planning. For a general discussion of the link between real options theory and IT investment planning, readers are referred to Campbell (2002) and Amram, Kulatilaka and Henderson (1999).

As all real options models inevitably depend on some specific assumptions, their appropriateness should be scrutinized under different scenarios. This study aims to provide a framework that will help IS researchers to better understand the real options models and to apply them more rigorously in IT investment evaluation.

As the technology changes, the basic economic principles underlying the real options theory do not change. So we do not need a brand new theory, but we do need to integrate the IT dimension into the real options-based investment decision-making process.

Using an electronic brokerage's investment decision in wireless technology as a real-world example, we show the importance of adopting appropriate real options models in IT investment planning. By specifically focusing on the uncertainties caused by IT innovation and competition, our study also gives some intriguing results about the dynamics between IT adoption and the technology standard setting process.

REAL OPTIONS THEORY

The seminal works of Fischer Black, Robert Merton and Myron Scholes offer us a standard pricing model for financial options. Together with their colleague at MIT, Stewart Myers, they recognized that option pricing theory could be applied to real assets and non-financial investments. To differentiate the options on real assets from the financial options traded in the market, Myers coined the term "real options" that has been widely accepted in academic and industry world. It is generally believed that the real options approach will play a more important role in the highly uncertain and technology-driven digital economy. Before reviewing the real options literature body that is growing very rapidly, we use two examples to give readers an intuitive illustration of the values of real options and their significance in financial capital budgeting.

Example 1. This Year or Next Year?

A software company is facing a new investment opportunity. It plans to spend \$100,000 to make its best selling database system compatible with an emerging Operating System (OS) in the market. But as the new OS is still in its infancy, the company is not sure whether it will be widely accepted in the near future. Suppose that the uncertainty about the new OS can be totally resolved next year; the company is trying to maximize its expected return form the \$100,000 investment project. According to the company's estimation, the new OS has a 50% chance to be widely accepted next year. In this case, the expected increased cash inflow from this investment is estimated to be \$15,000 a year. In the case that the OS is not popular next year, the expected annual net cash inflow from this project will be \$7,000. Suppose that the discount rate for this investment project is 10%, the NPV (Net Present Value) of this project can be calculated as:

$$NPV = -100{,}000 + \sum_{t=1}^{\infty} \frac{(15{,}000 + 7{,}000)}{2 * (1.1)^t} = 10{,}000$$

Since the NPV of this project is positive, it seems that we should go ahead with this project. However, the conclusion is incorrect because it does not count the value of the option of deferring the investment to the next year. Suppose that the company waits one year to watch the market reaction to the new OS; if a favorable situation occurs, it proceeds to invest, otherwise it gives up the project. This time the NPV of this project turns out to be:

$$NPV' = \frac{0.5}{1.1}\left[\sum_{t=1}^{\infty} \frac{15{,}000}{(1.1)^t} - 100{,}000\right] = 22{,}727$$

Obviously, it is better to defer the investment to the next year, and the value of this option is \$22,727-\$10,000 = \$12,727. Someone may argue that the investment costs will increase in the next year. In fact, further calculation shows that the option is still valuable even if the costs are as high as \$127,000 in the next year. Basically, this simple example shows the value of an option of deferring investment. In the next example, we discuss the value of a growth option.

Example 2. Pioneer Venture: The Value of a Growth Option

In this example, the management of a large pharmaceutical company wants to decide whether to acquire a young biomedical lab. If they decide to acquire it, they should provide \$100,000 funding to cover the initial costs for the pioneer venture. Five years after the initial funding, the management will decide whether to stop the pioneer venture or to expand it significantly according to the market situation at that time. If they choose to expand it, an additional \$1 million is needed. The cost of capital is assumed to be 15%. Five years after acquisition of the lab, the management will face two scenarios. The good scenario will occur with 60% while the bad one will have 40% happen. All expected future cash flows during the next 10 years are given in Table 1. Using the standard capital budgeting method, we can find that the NPV for the pioneer venture is -\$15,215. For the period of large-scale production, the NPV is -\$71,873. As the NPVs for both periods are negative, it seems that the management should give up the acquisition.

However, the acquisition will be a good investment if we consider the growth option associated with it. By acquiring the lab, the company also buys a growth

Table 1: Projected Cash Flows in the Example of Pioneer Venture Project

Year	Pioneer Stage	Larger Scale Stage	Total Cash Flows	Discount Rate
0	-$100,000		-$100,000	15%
1	$10,000		$10,000	
2	$10,000		$10,000	
3	$50,000		$50,000	
4	$50,000		$50,000	
5	$20,000	-$1,000,000	-$980,000	
6		$100,000	$100,000	
7		$100,000	$100,000	
8		$500,000	$500,000	
9		$500,000	$500,000	
10		$200,000	$200,000	
	Large Scale Stage	Good Scenario	Bad Scenario	Prob (good)
5	-$1,000,000	-$1,000,000	-$1,000,000	0.6
6	$100,000	$130,000	$55,000	
7	$100,000	$130,000	$55,000	
8	$500,000	$650,000	$275,000	
9	$500,000	$650,000	$275,000	
10	$200,000	$260,000	$110,000	
	NPV Pioneer Stage	-$15,215.42		
	NPV Large Scale Stage	-$71,872.54		
	NPV with Growth Option	$13,749.98		
	Value of the Option	$28,965.40		

option that enables it to expand the lab when the conditions are favorable five years later. In this case, the good scenario will occur with 60%. After simple calculation, it is easy to find that the growth option has a value of $28,965. Combining its value with the negative NPV during the pioneer venture period, the adjusted NPV of the acquisition is $13,750, which means this investment is strategically plausible.

In both of the above examples, we can easily calculate the values of the real options. The reason is that we make stringent assumptions on the distribution of future cash flows to simplify the calculation. In the real business world, option pricing is far more complicated. Fortunately, we can adopt some standard tools and concepts from option pricing theory to evaluate real-world investment opportunities.

An option is the right, but not the obligation, to buy (a call) or sell (a put) an asset by a pre-specified price on or before a specified date. For financial option contracts, the underlying assets are usually stocks. Until late 1960s, people had failed to find a rigorous method to price the options. Based on the Ito Calculus and the concept of dynamic portfolio hedging, Black and Scholes (1973) and Merton (1973) successfully found the fundamental partial differential equation that must be satisfied by the value of the call option and gave the analytical solution known as the Black-Scholes formula. The well-known formula is based on several standard assumptions. One of them is that the underlying stock prices follow a geometric Brownian motion. Since it is very hard to understand real options models without basic knowledge of the underlying stochastic process, we briefly describe it here. First, we define the Wiener process that is also well known as the Brownian motion.

Wiener process (Brownian motion): A stochastic process z(t) is a Wiener process if any change in z, namely dz, during a time interval dt has following properties:

(a) $dz = \varepsilon \sqrt{dt}, where \varepsilon_t \sim N(0,1)$

(b) $E(\varepsilon_t \varepsilon_s) = 0 \forall t \neq s.$

Based on the Wiener process, a geometric Brownian motion can be defined as:

$$\frac{dx}{x} = \alpha dt + \sigma dz,$$

where dz is a Wiener increment. Obviously, the absolute changes in x are lognormally distributed in this stochastic process. Geometric Brownian motion is frequently used to model stock price, interest rate, wage rate and other economic variables. Figure 1 depicts four sample paths of a standard Brownian motion. Three sample paths of a Geometric Brownian motion are showed in Figure 2. Many studies extended Black, Scholes and Merton's work or proposed other option

Figure 1: Sample Paths of a Standard Brownian Motion

$$dw = \sigma dz, w_0 = 0, \sigma = 0.5$$

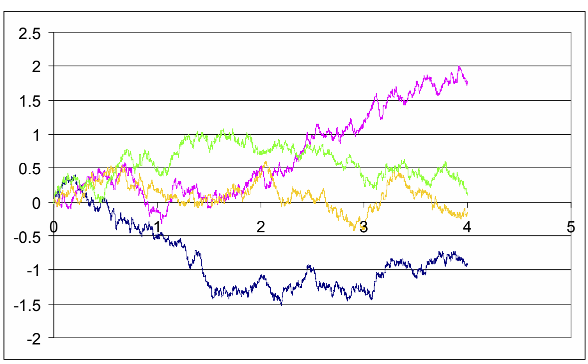
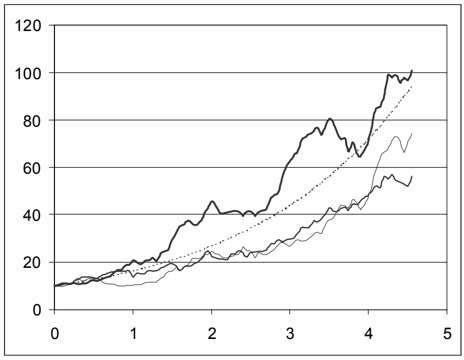


Figure 2: Sample Paths of a Geometric Brownian Motion

$$\frac{dx}{x} = \alpha dt + \sigma dz, x_0 = 10, \alpha = 0.5, \sigma = 1$$



pricing approaches. Cox, Ross and Rubinstein (1979) proposed a simplified option pricing approach based on a multiplicative binomial process that approximates a geometric Brownian motion in its continuous-time limit. For non-technical introduction to options and option pricing theory, see Brealey and Myers (1996).

Following the revolution in option pricing theory, many researchers recognized the potential of this theory in capital budgeting because traditional DCF (Discounted Cash Flows) technique has its inherent limitation in valuing investments with strategic options and many uncertainties. Myers (1977) shows that a firm's discretionary investment options are components of its market value. Mason and Merton (1985) discuss the role of option pricing theory in corporate finance. Kulatilaka and Marcus (1988) also discuss the strategic value of managerial flexibility and its option-like properties. Table 2 gives a comparison between an American call option on a stock and a real option on an investment project. Despite the close analog, some people may still question the applicability of option pricing theory on real options that are usually not traded in a market. However, Cox, Ingersoll and Ross (1985) and McDonald and Siegel (1984) suggest that a contingent claim on a non-traded asset can be priced by subtracting a dividend-like risk premium from its growth rate.

Based on the solid theoretical foundation, many researchers have investigated the valuation of various real options in the business world. One of the most basic real option models was developed by McDonald and Siegel (1986). In their model, they discuss the optimal time for a firm to invest in a proprietary project whose value evolves according to a geometric Brownian motion. Their results suggest that the option to defer an investment may be very valuable under some circumstances. Ingersoll and Ross (1992) also discuss the option of waiting to invest and its relation

Table 2: Comparison Between an American Call Option and a Real Option on a Project

AMERICAN CALL OPTION ON STOCK	REAL OPTION ON A PROJECT
Current Stock Price	Present Value of Expected Cash Flows
Option Exercise Price	Investment Cost of a Project
Right to Exercise the Option Earlier	Right to Invest in the Project at Any Time Before the Opportunity Disappears
Stock Price Uncertainty	Project Value Uncertainties
Option Price	Value of Managerial Flexibility Associated with the Project
Expiration Time	Time Window of the Investment Opportunity
Traded in Financial Market	Usually Not Traded
Easy to Find a Replicating Portfolio	Hard to Find a Replicating Portfolio

with uncertainty. Brennan and Schwartz (1985) examine the joint decisions to invest and abandon a project. Kulatilaka and Trigeorgis (1994) adopt the real option theory to value the managerial flexibility to switch inputs and outputs. Grenadier (1995) discusses how to value lease contracts by real options theory.

Recent development in real option theory focuses on the valuation of more complicated real options like shared options, compounded options and strategic growth options: Dixit and Pindyck (1994) examine the dynamic equilibrium in a competitive industry. Their model suggests that a firm's option to wait is valuable when uncertainty is firm-specific. For industry-wide uncertainty, there is not value to wait because of the asymmetric effects of uncertainty. Smit and Ankum (1993) apply real option theory and game theory to corporate investment decision under competition. Trigeorgis (1996) extends the analysis to value the impact of random competitive arrivals. In the real world, a company usually faces a set of real options that may interact with one another. Trigeorgis (1993) also examines the interaction between several options and argues that subsequent options can influence the value of earlier options. Grenadier (1996) discusses the strategic exercise of options in the real estate market. Sahlman (1997) shows how investors evaluate the growth options embedded in start-up ventures. Grenadier and Weiss (1997) apply the option pricing approach to investigate the investment behavior of a firm facing sequential technological innovations. Huchzermeier and Loch (2001) critically evaluate the strategic value of managerial flexibility in R&D projects. Kulatilaka and Perotti (1998) quantitatively show that the gains of strategic preemptive investment sometimes outweigh the loss from early commitment to a project with many uncertainties. Their results suggest that strategic considerations sometimes play a dominant role in investment timing. Bernardo and Chowdhry (2002) use real options theory to explain the changes in corporate resource allocation strategy over time. Pindyck (2002) discusses the timing of environmental control policies within the context of the option pricing theory.

A typical IT investment project requires significant initial outlay and is generally irreversible or at least partially irreversible. In addition, IT investments usually have huge business and technological uncertainties. All these characters make real option theory an appropriate approach in evaluating IT investment projects. As pointed out by Amram, Kulatilaka and Henderson (1999), real options in IT investments can create shareholder value in demonstrable ways. Li and Johnson (2002) and Kim and Sanders (2002) critically discuss how to apply real option theory to various strategic IT investment scenarios.

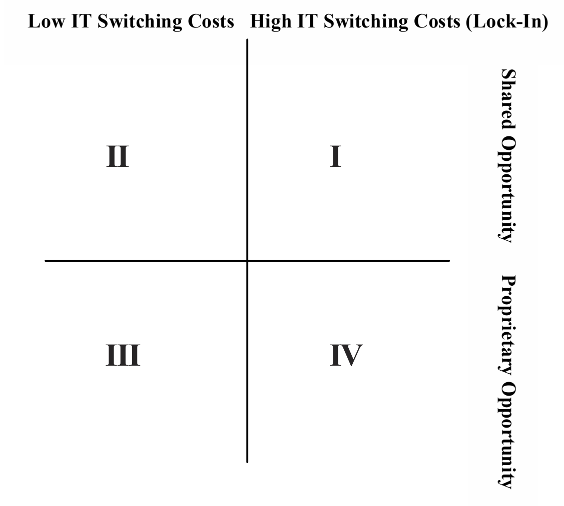
FOUR CATEGORIES OF IT INVESTMENT OPPORTUNITIES

Recognizing the potential of real options in capital budgeting, many major companies are beginning to apply it in a variety of contexts. Amram and Kulatilaka (1999) give a portfolio of real options applications including new venture valuation, infrastructure investment, land valuation, R&D and strategic investment planning. Paddock, Siegel and Smith (1988) value offshore petroleum lease and subsequent exploration options. Luehrman (1998a) shows how to simplify real options theory and apply it to real business operations. Bulan (2000) reports some new empirical evidence that is consistent with real options theory. Capozza and Li (1994) argue that the true value of a vacant urban land should include the option value of alternative future development. Teisberg (1994) performs an option valuation analysis of investment choice by a regulated company.

Recently some studies of real options theory have been done in valuing IT investment projects. For example, Benaroth and Kauffman (1999, 2000) conduct a case study to analyze a financial service industry IT project in the framework of real options. Using real options analysis, Taudes, Feurstein and Mild (2000) critically justify a corporation's investment decision in a SAP R/3 system.

Like most theories, real options theory is not a panacea. Its applicability should be scrutinized under different investment scenarios. Although some IS researchers have begun to use real options theory as a tool in IT investment evaluation, they did not provide a framework where the issue of applicability could be addressed. The major goal of this work is to establish such a framework. To achieve the goal, we classify IT investment opportunities into four categories based on two criteria: the technology switching costs and the nature of competition. As shown in Figure 1, we

Figure 3: Four Categories of IT Investment Opportunities



have four types of IT investment opportunities based on the two criteria: (i) shared opportunities with high IT switching costs; (ii) shared opportunities with low IT switching costs; (iii) proprietary opportunities with low IT switching costs; and (iv) proprietary opportunities with high IT switching costs. It is worth noting that each category has distinctive requirements on the application of real options models. We use the continuous-time model developed in McDonald and Siegel (1986) as a benchmark to show why we differentiate IT investment opportunities based on the two criteria. Their model suggests that the investment opportunity is equivalent to an American call option—the right but not the obligation to invest in the project at a known cost. Without intermediate cash flows and competitive erosion, this model has an explicit closed form solution. This analytical solution possesses many important characteristics. It basically suggests that the option to defer uncertain investment is very valuable and should be taken into account when a company makes investment decisions.

A major assumption of this model is that there is no competitive erosion; in other words, the investment project is a proprietary opportunity. Without this assumption, the value of the project should not follow the symmetric geometric Brownian motion described in their model. The reason is simple: the existence of potential competition makes the distribution of future project value asymmetric with high project value less likely to occur. It is worth noting that the well-known Black-Scholes option pricing formula is also based on the assumption that the underlying asset price follows the geometric Brownian motion. So even direct application of this formula is inappropriate when several competitors share the investment opportunity. In the real business world, most investment opportunities are shared or at least partially shared. Especially in the IT business sector where intensive competition is pervasive, those real options models assuming symmetric uncertainty in investment opportunity value are generally inappropriate. Intuitively, competition pressure will decrease the value of the option to defer an investment.

There are usually two approaches to deal with this issue. One approach is to model the competitive entries as exogenous shocks. For examples, Dixit and Pindyck (1994) and Trigeorgis (1991,1996) use a Poisson Jump process to describe the competitive arrivals. Their studies show that the effect of the competitive erosion can be expressed as the following equation:

Strategic NPV = NPV + (Value of Option to Wait - Competitive Loss)

In other words, strong competition will restrict managerial flexibility if the investment opportunity is shared. To extend real options to value investment opportunities with random competitive arrivals, Trigeorgis (1996) suggests that the competitive arrivals can be viewed as having an impact analogous to a continuous dividend payout.

The other approach is to endogenize the competitive interaction and to combine the real options valuation with game theoretical principles. Readers interested in this approach are referred to Smit and Ankum (1993).

As we mentioned before, most IT investments are shared by several competitors. So before we reach a conclusion, we must carefully compare the benefit of early preemptive investment and the value of the option to defer the investment. Applying those real options models that assume symmetric uncertainty on investment payoff is justified only when the opportunity is proprietary or at least not under competitive pressure in the foreseeable future. Some types of IT investment opportunities like internal IT system procurement and upgrade may possess this character.

However, we must evaluate the strategic effect of early investment before applying real options models to most IT investment projects. As suggested by Kulatilaka and Perotti (1998), the benefits of early preemptive investment may strategically dominate the benefits of waiting when the competition is very intense. In fact, we can treat the strategic effect of preemptive investment as the value of a growth option. So we still evaluate the investment opportunity in the context of the real options theory by considering the growth option and the waiting option simultaneously. Alternatively, we can incorporate the preemptive effect into the standard real options models. For example, Li (2001) proposes a real options model with strategic consideration based on the model in McDonald and Siegel (1986).

The other criteria we used to categorize different IT investment opportunities is the IT switching cost. We all know that future uncertainty makes the options embedded in an investment opportunity valuable. Theoretically, there is no need to single out technology uncertainty from all other uncertainties in the real options model. All these uncertainties have same effect: they make the future payoff of an investment project less predictable. However, we will concentrate on the technology uncertainty in this study because it plays a pivotal role in affecting IT investment payoff. Perhaps the most important question that management faces before committing an IT investment is whether the technology adopted is the right choice. More specifically, will the adopted technology be the best solution to maximize the expected investment payoff? Clearly there is not a simple answer to this question because there are so many uncertainties involved. Some very promising or popular IT solutions may become obsolete in a few years. In some other cases, some neglected IT solutions may evolve to be the standard solution. Nevertheless, most technology uncertainties can be resolved as the process of technology competition goes forward. A typical process of technology competition includes:

1. *Problem identification:* An important problem is identified and new technology is sought to solve it.
2. *Technology solutions proposition:* Several technology developers/vendors propose different solutions to solve the problem.
3. *Solution testing and comparison:* Different technology solutions are competing in the market and their effectiveness is tested and compared.
4. *Technology standardization:* The best solution will flourish over time. Based on it, the technology to solve the problem will be standardized.

For many IT investment projects, decision makers face an uncertain technology environment where several IT solutions are competing in the market. Obviously, the future successes of these projects will to some extent depend on whether the IT solutions adopted will win the technology competition. Consequently, decision makers do have an incentive to use the deferring option to let more technology uncertainties be resolved. Under this scenario, many option-to-wait models can be easily extended to find the optimal investment strategy. However, to apply these real options models, we must presume that there are significant technology switching costs once an IT solution is adopted. Otherwise, the uncertainties in technology competition will not make the option to wait valuable because the decision makers can easily switch to other IT solutions after they implement the investment project. As pointed out by Shapiro and Varian (1998), the IT switching costs are very significant in many cases. They use the term "technology lock-in" to describe the situation where management has little flexibility to switch to other technology solutions once they adopted one IT solution.

Now it should be clear why we use IT switching cost as the second criterion to classify different IT investment opportunities. When the IT switching cost is significant (technology lock-in), the option to wait is valuable. Therefore, real options analysis should concentrate on the managerial flexibility in deferring an IT investment to let more technology uncertainties be resolved. When the switching cost is low, high IT uncertainties cannot be used to justify the wait-and-see policy. On the contrary, we should use real options analysis to quantify the value of the option to switch that usually makes an investment opportunity more appealing to the management.

To summarize our discussion, let us look at the four categories of IT investment opportunities based on the two criteria.

Category I: Shared Investment Opportunity with High IT Switching Cost

For this type of IT investment opportunity, we must consider both the strategic benefit of early preemptive investment and the valuable option to wait. Potential competitive pressure forces investors to be proactive. However, preemptive investment will incur the loss of the valuable option to wait. So for this type of IT investment opportunity, the key in the real options analysis is to consider the strategic growth option and the option to wait at the same time. By balancing the two contradictory effects, we can find the optimal investment point at which the expected investment payoff will be maximized.

Category II: Shared Investment Opportunity with Low IT Switching Cost

For this type of IT investment opportunity, early preemptive investment is usually the best strategy. As we discussed before, it is beneficial to invest early to preempt potential competitors. Moreover, IT uncertainties will not make the wait-and-see strategy more appealing because the IT switching cost is low. Therefore, real options models should be used to quantify the values of the growth option and the switching option embedded in the IT investment opportunity.

Category III: Proprietary Investment Opportunity with Low IT Switching Cost

It is worth noting that the option to wait is a very valuable component of a proprietary investment opportunity. However, technology uncertainty will not contribute a lot to the value of the option to wait because the IT switching cost is low for investment opportunities in this category. Therefore, in the real options analysis, we should pay attention to other business uncertainties that may increase the value of the option to wait.

Category IV: Proprietary Investment Opportunity with High IT Switching Cost

Wait-and-see is the dominant strategy for this type of IT investment opportunity. Thus, real options analysis should concentrate on the option to defer an investment. With the presence of technology lock-in, decision makers should be more patient before they commit a proprietary investment.

In the real business world, an IT investment opportunity may dynamically evolve from one category to other ones. Therefore, decision makers should be very cautious when they conduct real options analysis. In the next section, we use a real-world case to show the importance of adopting appropriate real options models as the IT investment opportunity evolves.

A REAL-WORLD CASE

With the phenomenal growth of World Wide Web (WWW) and the emergence of other communications technologies, the Internet-based brokerage business is reshaping many aspects of the way we trade securities. The most prominent and appealing characteristic of on-line brokerage is that it provides individual investors a fast, economical and easily accessible channel of trading. In recent years, advances in encryption and other networking technologies make on-line investing more secure and dependable, which in turn spurs further development in the on-line brokerage business.

With the dramatic increase in the number of on-line brokerages, the competition of Internet-based brokerage business becomes more and more intensive. Consequently, the average commission investors paid per trade falls continuously, and more customer services are available to on-line investors. The latest telecommunications technology makes it possible for on-line investors to leave their PCs alone and trade via wireless networks. Thus, many electronic brokerage companies face an investment opportunity to build their wireless Internet trading infrastructure. Actually, the technology that enables high-speed wireless data access has been available for more than a decade. Several wireless Internet access solutions, including Phone.com's UP.browser, were available as early as 1996. However, no electronic brokerage company rolled out wireless trading service before late 1998. From 1998 to 2000, nearly 70% of top 20 electronic brokerage firms began to provide some kind of wireless trading services.

It is obvious that the investment opportunity in building a wireless trading infrastructure is a shared opportunity. It means that every electronic brokerage company has an incentive to invest earlier to preempt its competitors. But why did these brokerage companies not start to build their wireless trading services as early as 1996? Why did most companies commit the investment within the time period from late 1998 to 2000? We try to answer the questions based on real options analysis and our discussion in the previous section.

Before 1998, several wireless Internet access solutions were competing in the market and different wireless service providers were promoting their favorite solutions. It was very hard to tell which solution would be the future industry standard. Moreover, there was not a protocol or specification that could ensure the interoperability among these competing solutions. As a result, the switching costs among different solutions were very high. If a brokerage company decided to build its wireless trading service at that time, it would inevitably be locked in a solution. This situation was exactly what we described as Category I — shared opportunity with high IT switching cost. So an electronic brokerage company must consider both the strategic benefit of early preemptive investment and the valuable option to wait. Because of the lock-in situation, electronic brokerage companies adopted the wait-and-see strategy. This strategy is the best one when the value of the option to wait overweighs the strategic benefit to invest earlier.

Sometimes too aggressive an investment strategy ignoring the technology risks may lead to disasters. A recent example is the failure of Iridium project — a global satellite communications system. Several industry giants including Motorola committed millions of dollars to build a network of low-orbit satellites to provide global, portable phone service when there were many uncertainties surrounding the competition between the satellite system and the terrestrial cell phone system. The project turned out to be a disaster when the cell phone system became the standard global wireless communications channel. Iridium officially shut down its network and declared bankruptcy in early 2000.

The situation surrounding the wireless trading project changed in May of 1998. The WAP Forum, co-founded by Phone.com, Ericsson, Nokia and Motorola, published WAP 1.0 (Wireless Application Protocol 1.0) that is basically an open industry standard aimed at integrating mobile telephony and the Internet technologies. A major function of WAP is to ensure the interoperability among various wireless Internet solutions. As a result, different technology vendors can still compete in the market, but they volunteer to develop their products subject to the technical specifications set in WAP. Because WAP makes the competing technology solutions more interoperable and compatible, the switching costs among different solutions significantly decrease. Electronic brokerage companies have

Table 3: Real Option Based Discounted Cash Flow Analysis of the Wireless Trading Project

Investment Cost C	**$4,000,000**	**Growth Rate g**	**Discounted Rate r**
		20%	**30%**

Projected Cash Flows Assuming Technology Competition Ends in 5 Years

p=60%		(1/1/96)	
0	Win	Lose	
1996	$500,000	$500,000	
1997	$600,000	$600,000	
1998	$720,000	$720,000	
1999	$864,000	$864,000	
2000	$1,036,800	$1,036,800	
2001	$1,244,160	g=0%	
…g=20%		$4,492,800	**Expected NPV**
DCF	$1,000,000	-$1,420,083	**<u>$31,967</u>**

p=70%		(1/1/97)	
1	Win	Lose	
1997	$500,000	$500,000	
1998	$600,000	$600,000	
1999	$720,000	$720,000	
2000	$864,000	$864,000	
2001	$1,036,800	g=0%	
2002	$1,244,160		
…	g=20%	$3,744,000	**Expected NPV**
DCF	$769,231	-$1,247,505	**<u>$164,210</u>**

p=80%		(1/1/98)	
2	Win	Lose	
1998	$500,000	$500,000	
1999	$600,000	$600,000	
2000	$720,000	$720,000	
2001	$864,000	g=0%	
2002	$1,036,800		
2003	$1,244,160		
…g=20%		$3,120,000	**Expected NPV**
DCF	$591,716	-$1,088,897	**<u>$255,593</u>**

p=90%		(1/1/99)	
3	Win	Lose	
1999	$500,000	$500,000	
2000	$600,000	$600,000	
2001	$720,000	g=0%	
2002	$864,000		
2003	$1,036,800		
2004	$1,244,160		
…g=20%		$2,600,000	**Expected NPV**
DCF	$455,166	-$945,345	**<u>$315,115</u>**

p=100%		(1/1/00)	
4	Win		
2000	$500,000		
2001	$600,000		
2002	$720,000		
2003	$864,000		
2004	$1,036,800		
2005	$1,244,160		
…g=20%			**Expected NPV**
DCF	$350,128		**<u>$350,128</u>**

Introduction of WAP 1.0-An Exogenous Shock to Technology Competition Process

p=90%		(1/1/98)	
2	Win	Lose	
1998	$500,000	$500,000	
1999	$600,000	$600,000	
2000	$720,000	g=0%	
2001	$864,000		
2002	$1,036,800		
2003	$1,244,160		
…g=20%		$2,600,000	**Expected NPV**
DCF	$591,716	-$1,228,949	**<u>$409,650</u>**

p=100%		(1/1/99)	
3	Win		
1999	$500,000		
2000	$600,000		
2001	$720,000		
2002	$864,000		
2003	$1,036,800		
2004	$1,244,160		
…g=20%			**Expected NPV**
DCF	$455,166		**<u>$455,166</u>**

more flexibility in building their wireless trading platform because the chance of being locked in one solution is very small. With the presence of an open technology standard like WAP, the investment opportunity of electronic brokerage firms evolves from Category I to Category II, namely, shared investment opportunity with low IT switching cost. As we discussed above, early preemptive investment is usually the best strategy for this category.

In Table 3, we conduct a real options-based discounted cash flow analysis to demonstrate how the dynamics of technology competition may affect an electronic brokerage company's investment timing decision. We assume that an electronic brokerage company needs to decide whether to build a wireless trading platform at the beginning of 1996. In our analysis, we use 01/01/1996 as the benchmark starting time toward which all future cash flows are discounted. If the company decides to invest immediately, it needs to spend C=\$4,000,000 to cover the investment cost. It expects that the first year cash flow is CF_0=\$500,000 and this number will grow at an annual rate g=20% thereafter. However, the company knows that it faces the possibility of getting locked in a potentially failing technology because several incompatible technologies are competing in the market. It estimates that the technology competition process will end after 2000. The annual cash flow growth rate after 2000 will become 0% if the technology adopted loses in the competition. Based on the information available and the company's best knowledge at that time, it estimates that the possibility of adopting the right (potentially winning) technology is p=0.6. We assume that the annual discounted rate is r=30%. There are two reasons why we use a relatively higher discounted rate. First, most electronic brokerage companies have high costs of capital because they are in a very competitive and risky business. Second, this investment opportunity is nonproprietary, which suggests that the cost of waiting is high. Now suppose the company implements the project immediately, the expected NPV can be calculated as:

$$ENPV = p\sum_{t=0}^{\infty}\frac{CF_0(1+g)^t}{(1+r)^t} + (1-p)\left[\sum_{t=0}^{3}\frac{CF_0(1+g)^t}{(1+r)^t} + \sum_{t=4}^{\infty}\frac{CF_0(1+g)^3}{(1+r)^t}\right] - C$$

Given the specific parameter values, Table 3 shows that ENPV is equal to \$31,967. Since \$31,967>0, the company should commit the investment immediately based on traditional discounted cash flow analysis. However, the company knows that it has the option to wait to let more technology uncertainties be resolved. For example, it can defer the investment until 2000 when the technology competition is expected to end. At that time, the brokerage is 100% sure that it can adopt the right technology. We assume that the brokerage expects that p will grow from

0.6 to 1 with an annual increment of 0.1. In other words, the predictability of the future technology competition outcome grows linearly from 1996 to 2000, which is consistent with the fact that future uncertainties are resolved gradually. Based on this assumption, the company is able to calculate the expected NPV of the project implemented in each subsequent year after 1996. Table 3 shows that the expected NPV increases from 1996 to 2000 and reaches its maximum at $350,128. So under this scenario, the company should wait until all uncertainties are resolved in 2000. It is easy to prove that the expected NPV will decrease after 2000 when the technology competition ends. Without the presence of uncertainties, waiting can only incur costs due to the discounting effect.

Suppose that the technology competition process unfolds as the company expected, it adopts a wait-and-see strategy until 1998 in which the WAP 1.0 standard is established. We model the introduction of the WAP open standard as an exogenous shock to the technology competition process. More explicitly, the emergence of an open standard significantly reduces the uncertainties surrounding the technology competition process. In our analysis, we assume that p increases from 80% to 90% at the beginning of 1998 due to this shock. One year later, the uncertainties of the technology competition are fully resolved, that is p=100%. An alternative approach is to model the effect of WAP as an exogenous reduction in the switching costs among different competing technologies. The first approach is used in our analysis. However, the second approach should yield similar results because lower switching costs result to less technology uncertainties.

Table 3 shows the expected NPV of the project after this shock. The brokerage company's best strategy is to invest in 1999 and the expected NPV is $455,166. (Note: to facilitate comparison, we still use 01/01/96 as the benchmark starting time to calculate the expected NPV.) Thus, the introduction of WAP has two direct effects on the company's investment decision. First, it increases the expected investment payoff of the project because the outcome of technology competition is more predictable. Second, it makes the option to wait less valuable by reducing future technology uncertainties.

In the cash flow analysis, we do not consider other non-technology uncertainties that tend to further increase the value of the option to wait. It is also worth noting that the magnitude of NPV plays a very important role in determining investment timing. For some lucrative projects, the best strategy is to give up the option to wait and commit investment immediately. The reason is simple: the loss of NPV due to the discounting effect may dominate the value of the option to wait if immediate investment can generate significant NPV.

Our analysis of this real-world case suggests that the dynamics of the technology competition process play an important role in IT investment decision.

In a separate paper, we proposed a new real options model to further explore the interrelationship between technology competition and IT investment timing.

CONCLUSION

Although some recent studies recognized the potential of real options theory in evaluating strategic IT investment opportunities, we believe that the applicability of various real options models should be scrutinized under different scenarios. Standard real options models assuming symmetric uncertainty in future investment payoffs cannot be directly applied to the shared opportunities because of the competitive erosion. With the presence of potential competitive entry, real options analysis should balance the strategic benefit of preemptive investment and the value of the option to wait. IT switching cost is another important factor we must consider when we conduct real option analysis. As high IT switching cost or technology lock-in is very common in the digital economy, decision makers should pay more attention to the technology uncertainties before committing early investment to preempt their competitors.

Since the dynamics of the technology competition and standardization play an important role in IT investment decision, more studies should be done to incorporate it into the real options-based decision-making process. We also believe that further real options analyses should be conducted to explore the functions of open standard and technology interoperability in fostering IT investment. In addition to IT investment evaluation, the real options theory can also be used to tackle many other information resource allocation problems. Some interesting examples include IT upgrading, corporate information architecture planning and information system development.

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Chapter VII

Trust and Technology in Virtual Teams

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ABSTRACT

Pressured by the growing need for fast response times, mass customization and globalization, many organizations are turning to flexible organizational forms, such as virtual teams. Virtual teams consist of cooperative relationships supported by information technology to overcome limitations of time and/or location. Virtual teams require their members to rely heavily on the use of information technology and trust in coworkers.

This study investigates the impacts that the reliance on information technology (operationalized in our study via the user satisfaction construct) and trust have on the job satisfaction of virtual team members. The study findings *reveal that both user satisfaction and trust are positively related to job satisfaction in virtual teams, while system use was not found to play a significant role. These findings emphasize that organizations seeking the benefits of flexible, IT-enabled virtual teams must consider both the level of trust among colleagues, and the users' satisfaction with the information technology on which virtual teams rely.*

INTRODUCTION

For many organizations, survival requires competing in a rapidly changing, hypercompetitive and global marketplace. In order to compete in this type of environment, organizational processes are becoming more complex, dynamic and global in nature, thereby prompting many organizations to transform their organizational structures from large, hierarchical structures to agile, flexible, new structures. Goldman, Nagel and Preiss (1995) stated that agile organizations are "how more and more businesses, of all sizes and across all industries, are being run today in order to stay in business" (p. xvii). Virtual organizations and virtual teams, examples of such new structures, support organizational agility and flexibility; encourage cooperative, intra- and interorganizational relationships; use information technology (IT) to support these relationships; and allow businesses to compete more effectively (Lucas & Baroudi, 1994; Goldman, et al., 1995; Bensaou, 1997). While no single definition of virtual organization has been commonly adopted, this study defines a virtual organization as an organization constructed of cooperative relationships supported by information technology to overcome restrictions of time and/or location to meet specific objectives (see Chiesa & Manzini, 1997; Mowshowitz, 1997; O'Leary, Kuokka & Plant, 1997). Virtual teams are the application of the virtual organization structure at the workgroup level to create temporary teams that may cross functional and organizational boundaries for the completion of a specific task (Lucas & Baroudi, 1994). Although virtual teams are gaining in popularity among organizations that are seeking more flexible structures, relatively little is known about the nature of these new teams (Bell & Kozlowski, 2002). Research indicates, however, that the effectiveness of these teams may outperform traditional face-to-face teams (Schmidt, Montoya-Weiss & Massey, 2001).

It is important to distinguish between virtual structures and the use of telecommuting/telework, another means of overcoming geographic boundaries within a traditional organization. While virtual structures, as discussed below, involve a breakdown of traditional supervisor/employee control structures and an increase in colleague interdependence, telecommuting/telework often produces a higher level of supervisory control and less colleague interaction (Igbaria & Guimaraes, 1999). Given this disparity between the core dynamics, the telecommuting/telework findings are not generalizable to the virtual organization setting.

Leavitt (1965) depicted the form of an organization as a combination of structure, tasks, technology and people. His framework shows that changes in one component may have consequences on the other organization elements.

Researchers have long theorized about potential impacts, such as the elimination of middle management levels, that information technology could have on organization structures (Leavitt & Whisler, 1958). Advances in IT have supported the development of IT-enabled organization design variables that were not previously available. Table 1 summarizes findings from an exploration of IT-enabled design variables that organizations can use to supplant traditional design variables in the design of new organization forms, such as virtual organizations (Lucas & Baroudi, 1994). These findings apply to virtual teams as well.

These new variables depend on the use of IT to achieve division of labor and coordination of tasks that conventional organization design variables strive to accomplish. The impact of IT-enabled design variables on the other organizational components is central to the creation of virtual structures. These variables have allowed for the creation of virtual organizations and virtual teams through the ability to geographically disperse heavily interdependent tasks and facilitate communications and coordination among subunits and individuals.

Table 1: Conventional and IT-Enabled Design Variables

Class of Variable	*Conventional Design Variable*	*IT-Enabled Design Variable*
Structural	Definition of organizational subunits	Virtual components
	Linking mechanisms	Electronic linking
	Staffing	Technological leveling
Work Process	Tasks	Production automation
	Workflows	Electronic workflows
	Buffers	Virtual components
Communications	Formal channels	Electronic communications
	Informal channels/collaboration	Technological matrixing
Interorganizational Relations	Make versus buy decision	Electronic customer/ supplier relationships
	Exchange of materials	Electronic customer/ supplier relationships
	Communications mechanisms	Electronic linking

Goldman et al. (1995) noted that virtual organizations have five characteristics: opportunism, excellence, technology, borderless and trust. Opportunism means that virtual organizations are formed to meet specific objectives, and once those objectives have been met, the virtual organization is disbanded. Excellence stems from the combination of competencies using the "all-star" approach during the creation of the virtual organization to produce a synergistic organization exhibiting high competence in every aspect. The participating firms also provide the technology to enable the virtual organization, similar to the manner that core competencies are acquired by the virtual organization. The capabilities and technology provided to the virtual organization represent the best that the collective firms have to offer. The "borderless" aspect of virtual organizations alludes to the elimination of physical boundaries through the application of information technology. That is, the virtual organization exists as a logical collection of capabilities that does not necessarily conform to the traditional physical aspects of a business organization. The characteristic of trust arises from the same removal of physical limitations that makes the virtual organization a borderless entity. The removal of physical limitations and the dispersal of the virtual organization across traditional organization boundaries disrupt many control mechanisms found in traditional organizations.

Virtual teams, in a similar fashion, involve the creation of a team to meet a specific objective or complete a specific task. Since these teams are goal oriented, they are temporary and are disbanded once the goal has been achieved (Jarvenpaa, Knoll & Leidner, 1998). Virtual teams also represent excellence of skills because they are formed in a manner analogous to virtual organizations. Organizations employing the virtual team structure do so by assessing the skills necessary to achieve the specific goal of the team, then choosing individuals that possess these skills. The selection of individuals to comprise the team can be made without regard to the geographic location of the individuals. Often, individuals performing in these teams may be internationally dispersed and include constituents from other firms. These geographically and organizationally dispersed teams are made viable through the use of information technology (Dube & Pare, 2001; Townsend, DeMarie & Hendrickson, 1998). The interorganizational and international aspects of the virtual team interfere with, and often invalidate, traditional mechanisms for control of team members. Dube and Pare (2001) report that global virtual teams rarely, if ever, meet in a face-to-face environment. As a result, trust is believed to become a critical component in effective virtual team operation (Larsen & McInerney, 2002; Jarvenpaa & Leidner, 1998). Unlike the other characteristics of virtual structures, such as duration, and geographical and organizational dispersion that can be directly observed and controlled, the reliance on trust as a characteristic of virtual structures is a logical conclusion that is being explored in the research literature (Majchrzak et al., 2000).

Given the dynamic interactions among Leavitt's organization components, the implementation of a virtual structure and the technology to support it may potentially impact the other components in numerous ways. Researchers have already recognized that the unique characteristics of virtual structures will require the re-examination of existing theories and have called for additional research into areas such as trust, organizational context and team norms (Bell & Kozlowski, 2002; Majchrzak et al., 2000; Townsend, DeMarie & Hendrickson, 1998; Warkentin, Sayeed & Hightower, 1997). The current study focuses on the potential impact on the individuals participating in the virtual structure. More specifically, this study investigates the impact of trust and user satisfaction with the IT used to implement a virtual team structure on the job satisfaction of the virtual team members.

LITERATURE REVIEW

Virtual Teams and Trust

Trust has frequently been assumed to be one of the key ingredients necessary for a virtual organization or team to be successful (Suomi, 1988; Konsynski, 1993; Duffy, 1994; Handy, 1995; Cohen, 1997). Currall and Judge (1995) defined trust as "an individual's behavioral reliance on another person under a condition of risk" (p. 153). Empirical research into the role of trust in the virtual organization setting, however, is lacking.

The role of trust, or the lack of trust, in human behavior as it pertains to the development of organizations and teams can be clarified using transaction cost economics (TCE) (Williamson, 1975). TCE explains the development and growth of organizations and teams as a solution to the costs of conducting transactions in a market. The principle components of TCE are opportunism, bounded rationality, small-numbers bargaining and uncertainty. Opportunism is the behavioral tendency of an entity, either an individual, a team or an organization, to act in its own self-interest, even at the expense of another entity. Bounded rationality describes the limitations placed on an entity in determining behaviors that are in its self-interest due to limited or imperfect knowledge. Small-numbers bargaining refers to a shift in negotiating power that occurs when only a small number of entities in a market can meet the needs of another entity. Uncertainty is defined as the inability to predict relevant future events (Williamson, 1975).

Transaction cost economics posits that there are costs associated with conducting transactions in a market, such as searching costs, transportation costs and communication costs (Gurbaxani & Whang, 1991). These costs are complicated by the presence of uncertainty so that entities have difficulty in predicting future demand and supply. To reduce transaction costs, entities may create standing relationships with each other in the form of contracts. Even though transaction costs are associated with the creation and enforcement of the contract, use of the contract may still be more economical than transactions in a market. Because each entity in the relationship has limited knowledge of the activities of the other entity, the potential for opportunistic behavior still exists. That is, the entity is restricted by its bounded rationality, so its transaction costs increase while the other entity enjoys greater profit. To prevent this opportunistic behavior, the contract must account for contingencies, causing an increase in the costs of writing and enforcing the contract (Perrow, 1986; Gurbaxani & Whang, 1991). Opportunistic behavior may also occur if either entity in the relationship must deal with uncertainty in a fluctuating industry. To prevent opportunistic behavior, contractual costs are increased as contingencies are taken into account.

During the course of the relationship, entities make investments in the relationship, such as time spent learning procedures and the development of communication channels. If these investments are significant, they can be a catalyst for small-numbers bargaining at the time of renegotiations. Small-numbers bargaining allows one entity to act opportunistically against the other to achieve greater profit while still engaging in a relationship that is more economical to both entities than leaving the relationship.

In order to reduce the costs of opportunistic behavior, and the costs of protecting against opportunistic behavior, one party of the relationship may assume authoritative control over the other through acquisition. While opportunism, bounded rationality, uncertainty and small-numbers bargaining still exist as influences within the organization created by that acquisition, they can be curbed through the exercise of authority.

In terms of transaction cost economics, virtual organizations and teams represent the transition from large hierarchical structures to flatter, collaborative structures (Drucker, 1988). By losing the authoritative control of the hierarchical structure, the members of the virtual organization and team must deal with greater risks of opportunism from the individuals that they must collaborate with and rely upon. Researchers have proposed that the environment created by a virtual structure will force its members to rely more heavily on trust instead of relying on control structures to ensure the performance of others (Clemons & Row, 1992; Konsynski, 1993; Bleecker, 1994; Handy, 1995; Barner, 1996; Cohen, 1997).

In addition to the application of TCE to the issue of the relationship between trust and job satisfaction, other research efforts have indicated that there is a relationship between trust and satisfaction. Larsen and McInerney (2002) looked at inter-university virtual teams developing information products and found that team performance was closely related to issues of trust. Lurey and Raisinghani (2001) found that relations among virtual team members had a very strong relationship to virtual team performance and virtual team member satisfaction. Interestingly, Lurey and Raisinghani (2001) found little relationship between internal group dynamics, and team performance and team member satisfaction. This is in direct contrast to Montoya-Weiss, Massey and Song (2001), who found that management of internal conflict was critical to virtual team performance. Driscoll (1978) investigated the influences of trust and participation in decision making on job satisfaction. He concluded that trust is a strong predictor of overall job satisfaction. Rich (1997) found trust to be the key moderator of the effects of role modeling on job satisfaction and performance. Based on this discussion, this study derives Proposition 1. (For a thorough examination of the role of trust in traditional organization and team structures, see Reina & Reina, 1999).

Proposition 1: Trust in other members of the virtual team has a significant, positive impact on job satisfaction.

Virtual Teams and User Satisfaction

The use of the IT-enabled design variables involves changes in technology that impact the personnel of organizations and teams (Lucas & Baroudi, 1994). The exact nature of the impact will be contingent on various factors such as the characteristics of the technology, the personal characteristics of the individuals involved, and other organizational and team characteristics such as culture. Delone and McLean (1992) indicated that user satisfaction could be used to assess the impact of a new information system on users' jobs.

The IT-enabled nature of virtual organizations and teams causes employees to rely heavily on IT to complete and coordinate tasks (see e.g., Legare, 2001; Barnatt, 1997). Therefore, the degree to which the system meets the employee's information needs is of critical importance. Suchan and Hayzak (2001) reported in their case study of the use of virtual teams in a Fortune 500 organization that team members' attitudes toward the technology were vital to the success of the virtual team structure. Larsen and McInerney (2002) found that virtual team members' perceptions of the virtual team experience were influenced by their perceptions of the technology used to implement the virtual structure. Malhotra, Majchrzak, Carman and Lott (2001) conducted a case study of virtual teams at Boeing-Rocketdyne. Malhotra et al. (2001) reported that the technology used by the virtual team was so critical to the virtual team members that 23 versions of the technology, based on recommendations of the team members, were developed throughout the life of the virtual team, and a dedicated technology facilitator was deployed to each teleconferencing session. Cyert and March (1963) suggested that when a formal information system exists, the degree to which the system succeeds in meeting the user's information needs will impact the user's feeling of satisfaction with the system.

Based on the extensive job satisfaction and user satisfaction literature, this study theorizes that user satisfaction will be positively related to the virtual team member's job satisfaction. For example, Ang and Soh (1997) and Yoon and Guimaraes (1995) provided empirical support for a positive relationship between user satisfaction and job satisfaction. This discussion provides the basis for Proposition 2.

Proposition 2: A user's satisfaction with the information technology used to enable the virtual team has a significant, positive impact on the user's job satisfaction.

Virtual organizations and teams may require increased usage by organization members of the information technology necessary to implement the IT-enabled design variables. Along with user satisfaction, system use is widely utilized in the literature as a surrogate for IS success or IS effectiveness (Lucas, 1978; Swanson, 1988; Igbaria, Guimaraes & Davis, 1995). Many studies have investigated the factors that determine system usage at various levels of analysis, including organizational, individual and system (Guimaraes & Igbaria, 1997; Lucas, 1978; Zmud, 1979; Fuerst & Cheney, 1982; Franz & Robey, 1986; Swanson, 1988; Davis, Bagozzi & Warshaw, 1989; Igbaria, 1990; Igbaria, Guimaraes & Davis, 1995). System usage is considered critical for organizations and teams to experience benefits from new technologies—a system that is not used provides no value, technological wizardry notwithstanding.

Previous research has used numerous self-reported indicators of system usage, although perceived daily use, frequency of use, number of applications used and number of tasks supported are the most widely used measures (Cheney & Dickson, 1982; DeLone, 1988; Igbaria, Guimaraes & Davis, 1995; Straub, Limayem & Karahanna-Evaristo, 1995). The perceived daily use measure attempts to identify the average amount of time that a user actually uses the system on days that the system is used. The frequency of use measure assesses the number of days within a time period that the system is used. The number of applications measure is used to determine the variety of applications that is used on the system, while the number of tasks supported is concerned with the number of different business tasks for which the user finds the system helpful.

Clemons and Row (1992) applied transaction cost economics to the area of cooperative relationships. They suggested that information technology could be used to lower transaction costs, and also reduce transaction risks. The reduction in transaction risks (through performance or task monitoring, for example) means fewer opportunities for opportunistic behavior. The increased potential for opportunistic behavior in the virtual organization or team is the reason that trust, the reliance on others under a condition of risk, is theorized to have importance. If system use reduces the condition of risk, then system use will moderate the impact of trust on job satisfaction, leading to Propositions 3, 3a and 3b.

Proposition 3: The amount of system use by a user will moderate the impact of that user's trust on his or her job satisfaction.

Proposition 3a: A high amount of system use by a user will weaken the impact of that user's trust on his or her job satisfaction.

Proposition 3b: A low amount of system use by a user will strengthen the impact of that user's trust on his or her job satisfaction.

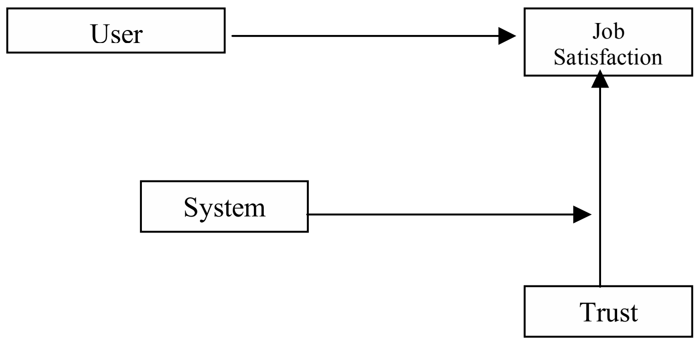
Research Model

As information technology advances continue to increase the ease with which virtual organizations and teams can be created, and businesses continue to find potential for competitive advantage through these virtual structures, their popularity will continue to grow. If, as postulated in the literature, the use of information technology to enable virtual organizations and teams requires changes in the behaviors and attitudes of managerial personnel to operate effectively, then businesses must be aware of the changes that will be necessary for their personnel.

Job satisfaction has been defined as "a pleasurable or positive emotional state resulting from the appraisal of one's job or job experiences" (Locke, 1976, p. 1297). Numerous studies have linked job satisfaction to a number of critical outcomes such as performance, propensity to leave and organizational commitment (Churchill, Ford & Walker, 1974, 1976; Michaels & Spector, 1982; Brooke & Price, 1989; Sullivan & Bhagat, 1992; Agho, Mueller & Price, 1993; Brown & Peterson, 1993; Singh, 1993; Levy & Williams, 1998).

Job satisfaction has been used as the dependent variable in the information systems (IS) research literature to assess the impact of a number of variables, such as previous computer experience, expert system developer skill, user satisfaction, management support and user characteristics (DuBrin, 1991; Gamst & Otten, 1992; Kahn & Robertson, 1992; Yoon & Guimaraes, 1995; Ang & Soh, 1997; Sankar & Yeong, 1997). This study, represented by the model in Figure 1,

Figure 1: Proposed Model



examines the impact of trust, user satisfaction and system use on the job satisfaction of virtual team members at an individual level of analysis.

MEASURES

Job Satisfaction

The job satisfaction construct is assessed through the use of the job descriptive index (JDI) developed by Smith, Kendall and Hulin (1969). JDI is one of the most extensively used measures of job satisfaction (Robinson, Athanasiou & Head, 1976; Brown & Peterson, 1993). The JDI provides a five-factor perspective of the job satisfaction construct, indicating that satisfaction with a job is a function of satisfaction with the work itself, the people in the job environment, supervision, pay and promotions. While Brown and Peterson (1993) suggested that a multi-faceted approach to job satisfaction yields a more robust assessment of the construct, not all five facets are as appropriate to individuals participating in virtual organizations and teams. Specifically, the use of cooperative relationships instead of a traditional control hierarchy renders the questions of supervision and promotion less applicable to this study. Therefore, this study uses only the work, people and pay scales of the JDI.

User Satisfaction

This study defines user satisfaction as the degree to which the user feels that the system meets his information needs (Ives, Olson & Baroudi, 1983). This construct is assessed through the use of the end-user computing satisfaction instrument developed by Doll and Torkzadeh (1988). Their instrument was developed to measure the satisfaction of individuals that make direct use of information systems for the completion of their jobs. Harrison and Rainer (1996) concluded that the instrument had acceptable psychometric properties as a general (unidimensional) measure of user satisfaction, and this study employs the instrument in that manner.

Trust

The trust construct in the current study is measured using the instrument developed by Currall and Judge (1995). The authors developed and tested their instrument for assessing trust among persons engaging in collaborative relationships. They identified four dimensions of trusting behavior: communication, informal agreements, surveillance and task coordination. The authors suggested that other researchers using their instrument might wish to use only the items related to the communication, informal agreement and surveillance dimensions of trusting behavior. They noted that these dimensions should be applicable in a wide variety of organizational contexts. They suggested that the items of the fourth dimension, task coordination, are too context-specific for applicability to other settings. Following the authors' suggestion, this study assesses trust using the communication, informal agreement and surveillance dimensions of the Currall and Judge (1995) instrument.

System Use

Measures of the utilization of information systems have suffered from discrepancies in the operationalization of system use (Igbaria, Guimaraes & Davis, 1995). In testing a model of the determinants of microcomputer usage, the authors reported that system usage is commonly operationalized in four ways in the literature: frequency of use, duration of use, variety of applications used and variety of tasks performed. This study employs all four operationalizations of system use.

RESEARCH METHODOLOGY

Subjects

Given the perceived likelihood of the use of virtual teams in the IS consulting industry, invitations to participate in the study were sent to 750 information system consultants and developers who performed at least a portion of their job functions at geographically dispersed locations. Responses from subjects reporting that they did not spend at least a portion of their time working in a virtual team environment were removed from the pool of usable responses. Of the 750 potential participants, 158 provided usable responses, giving a response rate of 21%. Raho, Belohlav and Fiedler (1987) indicated that a response rate of 20% on a blind mailing is an acceptable control against non-response bias.

Many respondents indicated in comments that they participate in virtual teams as a part of their jobs within traditional organizations. Several respondents also indicated that they participate in virtual teams as outside specialists working on a contract basis in "sideline" employment activities. The average percent of time spent in virtual team activities across respondents was approximately 50%.

Demographically, approximately 19% of the respondents were female, and respondents averaged approximately 37 years of age. Also, respondents indicated that they have been employed with the same organization for five years while working in the same position for less than 3.5 years. Table 2 shows that 68% of the respondents were in the consulting industry.

Survey Instrument

This study used a survey research methodology. The instruments for user satisfaction, job satisfaction, trust and the items assessing system use were compiled into a single survey instrument and implemented as a series of three WWW pages. The initial page explained the purpose and nature of the study, assured the respondents of the confidentiality of their responses and provided subjects with information about contacting the principal investigator if they had any questions. A hyperlink at the bottom of the initial page took the subjects to the actual survey instrument with general instructions provided at the top of the instrument and specific instructions at the beginning of each section of questions. A final series of questions gathered demographic information from the subjects. At the end of the instrument was a "Submit" button that submitted the completed questionnaire to the Web server and automatically took the subjects to the final Web page. The last Web page provided subjects with the opportunity to leave comments and the option of entering an e-mail address to receive an executive summary of the study's results.

The use of information technology to assist in the distribution and completion of survey research has been of interest to researchers in a variety of fields, such as medicine, psychology and marketing, for more than 15 years. While the apparent benefits of computer-assisted questionnaires (CAQs) over paper-and-pencil self-completion surveys (SCs) are many—including reduced cost of distribution and reduced time for converting responses into computer-format for statistical analysis—the issue of potential response bias due to the data collection method should be considered (Liefeld, 1988). A stream of research investigating the potential biasing effects of CAQ has emerged (e.g., George, Lankford & Wilson, 1992; Lautenschlager & Flaherty, 1990; Honaker, 1988).

Researchers investigating differences between CAQ and SC data collection methods have reported equivocal results. Some studies have reported significant differences between mean response scores across the two data collection methods

Table 2: Respondent Demographics

Industry	Frequency
Computer Consulting	80
Business Consulting	27
Computer Manufacturing	13
Finance	8
Manufacturing	8
Education	7
Other	15

(e.g., Kiesler & Sproull, 1986; Lautenschlager & Flaherty, 1990). Other studies have concluded that significant differences between CAQs and SCs in terms of mean scores do not exist (e.g., Kantor, 1991; Rosenfeld et al., 1989).

Previous research comparing CAQs and SCs has indicated two potential sources of bias: differences due to formatting characteristics and differences due to the immediacy of the technology. The use of CAQs with the current study is appropriate because the differences in formatting characteristics are minimized through the use of World Wide Web (WWW) design technology. The WWW design allows formatting of text with different fonts and layouts in a manner similar to paper surveys. Additionally, through the use of a single Web page layout to display the on-line survey, respondents are able to browse through the entire survey with complete control in returning to previous questions and changing previous answers. The graphical user interface also avoids the "initial cursor location" problem, which can bias respondents by suggesting a default answer to a question.

Although support for the immediacy differences between CAQs and SCs are not widely reported, the issue of immediacy of the technology when responding to computer-related items is considered a positive aspect of CAQ for the current study. The current study's investigation of user satisfaction and system usage relies on the respondent's ability to recall aspects of their use of information technology. The greater the ability of the respondents to recall their experiences, the more accurate the results of the current study should be. If the use of CAQs can help respondents to improve their recall of their use of IT, then the use of CAQs to collect data is preferred over SCs in this study.

The use of WWW technologies to collect data over the Internet introduces a new potential problem of its own. Because the data collection is to be completed on-line, controls are necessary to help ensure that the respondents only complete the survey once. While even conventional mailed surveys run the risk of a single person making multiple copies of the survey and returning multiple responses, the likelihood of this occurring may be higher with Internet-based data collection because the same ease of use that encourages participation by the respondents also allows abuses. To control for this possibility, respondents were encouraged on two occasions to enter their e-mail address after electronically submitting the questionnaire. In addition to the requests for the respondent's e-mail address, the Web page server logged the IP address of each person submitting a questionnaire. These IP addresses can then be used to check for, and eliminate, multiple responses from an individual.

Two problems remain with the use of IP addresses to check for multiple responses. First, one individual could use different computers to complete the questionnaire more than once. Second, more than one person could use the same computer in completing the questionnaire, causing one to be eliminated from the study. Although there appears to be no definitive solution to these problems, both were considered unlikely and the use of IP addresses did give the researchers a partial check on multiple responses.

Administration of the Survey

An e-mail cover letter was sent to 750 potential subjects from different organizations. The cover letter explained the nature of the research being conducted, provided a uniform resource locator (URL) pointing the subject to the survey instrument and assured the respondents of the confidentiality of their responses.

Two weeks from the initial mailing, a second mailing was made. All subjects who left an e-mail address requesting an executive summary were removed from the subsequent mailing lists to avoid unnecessary annoyance. Also removed from the mailing lists were any individuals who requested to be removed from the mailing list.

DATA ANALYSIS

The interitem reliabilities (standardized Cronbach's alpha) for the three JDI scales—satisfaction with work, people in the job environment and pay—produced reliability scores of .7724, .8788 and .8173, respectively. These three scales taken together resulted in a total interitem reliability score of .8937 for the responses to the JDI. The reliability analysis of the unidimensional user satisfaction instrument produced a Cronbach's alpha of .9312. The three sub-scales in the trust instrument—communication, informal agreement and surveillance—produced reliability scores of .6281, .7108 and .7298, respectively. Overall, the trust instrument had a reliability of .7428.

This study employed four measures of system use. Frequency of usage and duration of usage were each assessed as single-item measures. The variety of applications was assessed by having the respondents indicate which of a set of application program categories they used to support their virtual team activities. The number of application categories used is tallied for each respondent to produce a "variety of applications" measure, which in effect is a single-item measure. For s variety of tasks supported, respondents indicated on Likert-type scales the degree to which they use an information system to support each of eight activities.

Attempting to aggregate the four measures of system use into a single system use measure produced an unacceptably low reliability score of .4150, indicating that these four measures were not measuring the same construct. The original proposed model for the current study had considered system use to be a single construct. Based on the analysis of the system use measures, the original model was modified to better accommodate the four types of system use (Figure 2). Variety of tasks is the only measure of the four that was not a single-item measure. The items within the variety of tasks scale produced a reliability score of .6877.

Regression Analysis

Given the postulated intervening effect of system use on the relationship between trust and job satisfaction, moderated regression analysis was used to investigate the model of expected relationships (Parthasarthy & Sethi, 1993). Before the regression analysis was conducted, tests of the assumptions of normality, linearity and homoscedasticity for the error terms were conducted (Tabachnick &

Figure 2: Revised Research Model

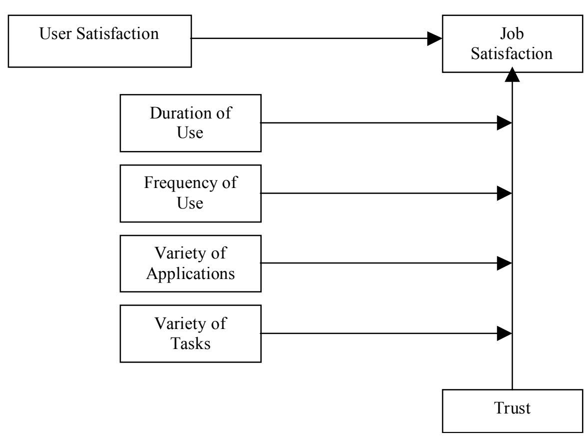


Table 3: Descriptive Statistics: Means, Standard Deviations, and Correlations for Dependent and Independent Variables

	Mean	S.D.	1.	2.	3.	4.	5.	6.	7.
1. Job Satisfaction	88.7	18.7	1.00						
2. Trust	63.4	12.5	.448**	1.00					
3. User Satisfaction	41.0	10.0	.350**	-.029	1.00				
4. Duration	4.4	1.3	- .010	.041	.003	1.00			
5. Applications	6.5	2.2	- .069	.055	-.032	.067	1.00		
6. Frequency	5.4	1.0	.180*	.233**	.183*	.389**	.126	1.00	
7. Tasks	28.1	5.7	- .024	-.058	.126	.204*	.286**	.250**	1.00

* $p < .05$
** $p < .01$

Fidel, 1983). The sample met all regression assumptions. Descriptive statistics and correlations among the constructs are presented in Table 3.

The regression model used job satisfaction as the dependent variable and included user satisfaction and trust as the main effect independent variables. Because the research model does not stipulate a direct impact of system use on job satisfaction, the regression model does not include a main effect for any of the system use measures. To assess the moderation effect of system use on the relationship between trust and job satisfaction, interaction terms, computed by multiplying the trust measure by the system use measures, were included (Parthasarthy & Sethi, 1993). Thus, because the four measures of system use must be considered as separate measures, the regression model included four interaction terms as prescribed by the revised research model. Table 4 presents the results of the regression analysis.

Research Propositions

The regression analysis supports the overall model ($p < .001$), and indicates that the current model explains 31% of the variance observed in job satisfaction. Proposition 1 postulated a positive relationship between trust and job satisfaction. The regression analysis supports the existence of this relationship ($p < .001$), while

Table 4: Regression Model with Job Satisfaction as the Dependent Variable

Independent Variable	Beta	t	*p*
Trust	.467	3.476	.001
User Satisfaction	.355	4.797	< .001
Trust x Duration	- .089	- .899	.371
Trust x Frequency	.109	.742	.459
Trust x Applications	- .041	- .452	.652
Trust x Tasks	- .036	- .338	.736
R^2		.340	
Adjusted R^2		.309	< .001

the beta value indicates that the relationship is positive. Therefore, Proposition 1 is supported by the analysis; a higher level of trust is associated with more job satisfaction.

Proposition 2 suggested a positive relationship between user satisfaction and job satisfaction. The regression analysis supports the existence of a relationship between user satisfaction and job satisfaction ($p < .001$). The beta coefficient for user satisfaction indicates that this relationship is positive. Therefore, Proposition 2 is supported by the analysis; more user satisfaction relates to higher job satisfaction.

Proposition 3 postulated that system use would have a moderating effect on the relationship between trust and job satisfaction. The regression model included the potential impacts of four measures of system use. The findings provided no support for a moderating effect from any of the four measures of system use: duration of use, frequency of use, variety of applications and variety of tasks ($p =$ .371, .459, .652 and .736, respectively). Therefore, the findings do not support Proposition 3; system use does not appear to moderate the relationship between trust and job satisfaction.

DISCUSSION

The data analysis supported the significant positive impacts of user satisfaction and trust on the job satisfaction of virtual team members. This study illustrates that, in a virtual team, user satisfaction and trust are also significant factors explaining 31% of the observed variance in job satisfaction.

The current study supports the literature suggesting that virtual teams rely more heavily on trust than do traditional teams, which tend to have stricter command and control hierarchies (Drucker, 1988; Handy, 1995). The study found that trust does have a positive relationship with job satisfaction in the context of virtual teams. This finding suggests that individuals who have a higher level of trust are more satisfied with working in the less structured, highly cooperative environment of virtual teams. Conversely, individuals that have a low level of trust are unsatisfied in such environments. This is in keeping with the findings of other researchers that have associated virtual team performance with trust-related issues (Larsen & McInerney, 2002). However, the importance of other issues related to geographically dispersed teams, such as cultural and language barriers, should not be overlooked and need to be addressed (Dube & Pare, 2001).

One of the defining characteristics of virtual organizations and teams is that they are unrestricted by traditional organizational boundaries and geographic concerns. Virtual organizations and teams use information technology to overcome the bounds of time and location to allow geographically dispersed members to communicate and coordinate tasks. These structures emphasize reliance by their members on information systems for necessary communications and task coordination information, which may be necessary to complete assigned tasks.

User satisfaction is the degree to which the individual feels that the information system meets his or her information needs. With the individual's greater reliance on the information system, the finding that user satisfaction and job satisfaction are positively related is expected. Users that feel the system does not meet their informational needs will have lower job satisfaction because they are working under conditions which do not give them all the information that they feel is necessary to complete their tasks. The importance of user satisfaction with the enabling technology supports the findings of other researchers that have addressed this issue from a different methodology, such as the case studies done by Legare (2001) and Malhotra et al. (2001).

The moderating effect of system use on the trust/job satisfaction relationship was based on the work of Clemons and Row (1992), who proposed that information system use could lower transaction risks, as described by the principles of transaction cost economics (TCE). These transaction risks constitute the condition of risk that requires trust in a virtual structure. The reason that trust is an important factor in virtual organizations and teams is because individuals must rely on cooperative relationships in a condition of risk—those risks being transaction risks in the terminology of TCE (Perrow, 1986). To assess the moderating effect of system use on the impact of trust on job satisfaction, a measure of system use was necessary.

Analysis of the four measures of system use indicated that the four measures do not assess the same construct. Therefore, the four operationalizations were treated as separate variables. The regression model assessed the moderating effect of each of the four operationalizations of system use on the trust-job satisfaction relationship. None of the measures of system use resulted in a significant moderating effect.

In regard to Propositions 3a and 3b, for each of the four operationalizations, the sample was divided into quartiles, and the highest and lowest quartiles were taken as high system use and low system use. The data analysis did not support the moderating effect of system use. In summary, system use was not found to have a moderating effect on the trust-job satisfaction relationship across any level of system use, using any of the four operationalizations of system use.

Implications for Researchers

Increasing reliance on information technology and collaborative relationships in virtual organizations and teams presents a new domain in which previous theories must be reassessed (Goldman, Nagel & Preiss, 1995). The current study found support for the relationship between user satisfaction and job satisfaction in a virtual environment. With the tight integration of the information technology into the virtual structure, future research on virtual organizations and teams, whether IS oriented or not, will need to consider the role of information technology.

In addition to the reliance on information technology, virtual organizations and teams also rely heavily on collaborative relationships based on trust. Traditional organizations have relied on strict control structures to monitor and control the performance of individuals (Drucker, 1988). These control structures often depend on the physical proximity of workers. Virtual organizations and teams tend to be "borderless" and span large geographic areas. Control structures that rely on physical proximity in traditional organizations are replaced with trust-based relationships in virtual structures. The current study found that an individual's level of trust for his coworkers is significantly related to his job satisfaction in a virtual environment. Future research on virtual structures will need to account for the importance of trust.

Another implication from this study addresses the issue of job satisfaction in a virtual organization or team. Traditional perspectives of job satisfaction may be biased by the structures that exist in a traditional organization. It is clear that the issues of satisfaction with promotion opportunities and satisfaction with supervision as they relate to job satisfaction will have to be re-evaluated in terms of virtual organizations and teams.

The final implication for researchers from the current study addresses the system use construct. This lack of consistency in the operationalization of the construct makes comparisons across research using the construct difficult. This issue is further complicated by the lack of a universally accepted self-report measurement instrument for the construct. Future research that attempts to employ a measure of system use must be specific in its operationalization of the construct and suspect in its metric.

Implications for Practicing Managers

The conclusions of this study can also provide guidance to practicing managers. The forces that propelled the development of virtual structures, such as the need for faster response times and customized production, continue to urge organizations to seek flexible organizational structures (Bleecker, 1994; Goldman, Nagel & Preiss, 1995). The findings of the current study indicate that in the implementation of a virtual structure, even at the workgroup level, managers must consider the impact that the virtual structure will have on the employees.

The current findings indicate that trust is an issue that must be considered when implementing a virtual structure. The positive relationship between trust and job satisfaction for members of a virtual team means that managers may want to engage employees in trust-building activities to foster the growth of trust among them. This trust building may include a number of activities such as the development of shared personal experiences and traditional team-building activities (Shaw, 1997).

Another issue of concern for practicing managers is the importance of user satisfaction. Virtual organizations and teams have an intense reliance on information technology to support communication and coordination of tasks among geographically dispersed individuals (Goldman, Nagel & Preiss, 1995). The findings of this study indicate that satisfaction with the information technology used to implement a virtual structure is significantly related to job satisfaction. With the reliance on information technology, it is important for employees to feel that the information system meets their information needs. This finding suggests the need for an increased focus on ensuring the effectiveness of information system development.

CONCLUSIONS AND LIMITATIONS

The current study contributes to a better understanding of the impact that trust and information technology have on the members of a virtual team. This study provides empirical support for the importance of both trust and user satisfaction on the employee's job satisfaction within the virtual team.

The results of this study suggest future research directions. Additional research into the impact of the virtual structure on its members is recommended. Job satisfaction is a commonly used measure of impacts on employees, but it is not the only one. Performance issues should also be considered by future research to assess a broader perspective of potential impacts.

Further research to develop the system use construct is recommended. The construct is not standardized in the literature, thereby making any cross-study comparisons difficult, if not impossible. Also, due to the lack of a validated instrument for assessing system use, there can be little confidence that measures of system use are accurately measuring the intended construct.

This research should be viewed as only the first step into understanding the implications of virtual teams. As more and more organizations employ this structure, at all levels, to gain the advantages of flexibility, it is important that researchers help practicing managers to anticipate the impacts that these changes may entail for their employees.

One potential limitation of the current study concerns the operationalizations of system use. Although system use has enjoyed great popularity among IS researchers, there is still no generally accepted operationalization for the construct. This problem may explain the lack of support the current study found for the propositions on the moderating effect of system use on the trust-job satisfaction relationship.

Another potential limitation of the current study concerns the computer-assisted questionnaire data collection method. Studies regarding the potential bias from CAQs (Kiesler & Sproull, 1986; Webster & Compeau, 1996) discovered potential problems with formatting issues and immediacy. Format differences were addressed in the current study through the use of WWW technology and the strengths of the hypertext markup language (HTML) to allow the on-line version of the questionnaire to closely mimic the format and completion method of a paper-and-pencil survey. Because the current study made use of respondents' recall of their use of information technology, the immediacy of the information technology in the respondents' minds was considered a positive aspect of CAQs. The body of research on CAQs is not extensive, and other potential biasing aspects may yet be found.

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Chapter VIII

An Architecture for Active and Passive Knowledge Management Systems

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ABSTRACT

Knowledge management systems (KMSs) offer an environment for organizations to manage their information assets (e.g., documents, databases, etc.). Existing KMSs passively employ knowledge by querying a database, showing a document, displaying a Web page, etc. KMSs can be extended to incorporate active components, such as expert systems and business rule systems. Currently, business rules reside in application code and database triggers. A KMS with an embedded expert system using business rules from the organization, combined with the connectivity of a server in a client/server

architecture, provides an excellent environment for automating business activities at both local and enterprise levels. The segregation of business rules into the knowledge tier (KT) should lower the cost of development and maintenance, increase accuracy and ensure corporation-wide consistency. In addition, knowledge verification tools are now being developed that will allow the computerization of less structured tasks, enabling another round of increased efficiency through computerization.

INTRODUCTION

Corporate rightsizings of the 1980s, combined with the information technology-driven productivity gains of the 1990s and the pending retirement of baby boomers, has and will result in the continued loss of enterprise and job-specific knowledge. The massive loss of intellectual capital resulting from these three events is an unacceptable consequence for most government and private organizations. Consequently, those organizations that can retain knowledge and use it to act upon business situations will have a significant competitive advantage.

Knowledge about an organization or industry is an intellectual asset that, although paid for in part by the employer, is difficult to control and manage. This is because knowledge is fragmented in documents, policies, procedures and other storage mediums. Managing knowledge also presents a challenge for management to retain the knowledge in a form that is easily retrievable. This is not an easy task, since the enterprise must first identify the location of all needed knowledge, and second determine the easiest way to retrieve it.

Before proceeding, three related but not interchangeable concepts need to be defined. Data is a set of discrete, objective facts about events. Information is organized data presented in context. Data becomes information when its creator adds meaning or value. Similarly, knowledge is derived from information, as information is derived from data. Knowledge can be viewed as information in context, together with an understanding of how to use it. Knowledge can be either explicit (knowledge which a person is able to make available for inspection) or tacit (knowledge which a person is unable to make available for inspection) (Davenport & Prussak, 1998; Brooking, 1999).

There are many definitions of knowledge management, but the Gartner Group's (1999) description seems most appropriate for the perspective expressed in this chapter.

> *"Knowledge management promotes an integrated approach to identifying, capturing, retrieving, sharing and evaluating an enterprise's information assets. These information assets may include databases, documents, policies and procedures, as well as the uncaptured tacit expertise and experience stored in individual workers' heads."*

As the definition implies, information assets are plentiful and are stored in numerous locations throughout an organization. Storage options include books, manuals, documents found in document management systems, groupware processes found in Lotus Notes and expert or knowledge-based systems (Brooking, 1999). Physically, these information assets can be electronically stored on compact disc, laser disc, mechanical hard drives, microfilm, microfiche and embedded in computer programs.

The management of knowledge in this way is a positive approach to solving the knowledge drain problem. Yet, the knowledge stored in this type of KMS is passive. Active knowledge components will increase efficiency, lower costs, automate less-structured domains and yield a competitive advantage. They can be used as the foundation for the highest level of automation, "lights out" technologies.

The active KMS architecture discussed in this chapter provides an integrated approach to creating, verifying, delivering, sharing and evaluating an enterprise's knowledge assets. This is achieved by using active knowledge components such as expert systems and business rules, to support the organization's goals and objectives.

We use the term *active systems* to refer to computer programs that perform tasks without human intervention. These tasks may be as simple as counting cars to determine traffic volume or as complex as the "fly-by-wire" control systems used in jet aircraft. The significance of the *active system* designation is that no human will evaluate the outcomes produced by the system, which means that the computer program must react flawlessly to every possible scenario.

The need for accuracy in active systems cannot be overemphasized—a single bad outcome in a medical program could kill a patient, while a single bad outcome in a business program could put the company out of business. Currently, most active systems are embedded in database triggers and application code. The task of ensuring complete accuracy is the responsibility of the individual programmer. This approach makes it difficult to locate and compare knowledge.

The creation of an active systems component in the knowledge tier would allow knowledge-based active assets to be created by specialists, distributed throughout the company and integrated. Complex active systems require extensive verification that is not possible in the current environments, but which can be provided in a dedicated environment. The client/server implementation will allow executable programs to be used by any authorized user and allows intelligent components to be shared with application programs. The segregation of knowledge sources into a common location and environment facilitates their integration into new knowledge sources. As transaction databases are used to create data warehouses, so can knowledge sources be integrated to create new knowledge sources. Knowledge from data, data analysis, user forums, external sources and individuals can be combined into "best practices," expert systems or active systems.

The remainder of this chapter develops and justifies a proposed client/server architecture to build a manageable active KMS that uses digital forms of both active and passive knowledge.

THE ARGUMENT FOR A CLIENT/SERVER ARCHITECTURE

In a world of multiple computer languages, database management systems, assorted collaborative and group support software, network technologies and data storage methods, it can be a difficult and complex problem to locate and retrieve enterprise knowledge. If KMS promotes an integrated approach to identifying, capturing, retrieving, sharing and evaluating an enterprise's information assets, then the challenge is to get the right information to the right person at the right time.

"An integrated and integrative technology architecture is a key driver for knowledge management systems (KMSs)…knowledge management systems seem to require a variety of technologies: database and database management, communication and messaging, and browsing and retrieval. The need for seamless integration of the various technologies may lead to the dominance of the Internet and Internet-based knowledge management system architectures" (Alavi & Leidner, 1999). Organizational intranets will play a dominant role in the support of internal knowledge management activities due to cost-effective technical capabilities, including: access to the legacy systems, platform independence, access to multimedia data formats, a uniform and easy-to-use point-and-click interface, and the capability for easy multimedia publication for knowledge sharing (Alavi et al., 1999).

The benefits of these "knowledge-enabled intranets" include (O'Dell, Grayson & Essaides, 1998):

1. Lower communication costs, driven by reducing expenses related to printing, mailing and processing of documents.

2. Improved productivity by making information more widely and quickly accessible.
3. Higher team productivity, created through collaborative work environments.
4. Rapid implementation as a result of open protocol standards.
5. Relatively low costs for hardware and software.

We agree in general with the above conclusions and benefits, but believe that focusing only an Internet/intranet architecture greatly limits the capabilities of the KMS. The Internet/intranet is an excellent delivery vehicle, but imposes many restrictions when considered as the physical repository of knowledge.

We must also express some other cautions. While the common availability of knowledge may enable some tasks (Scholten, 1998), the knowledge must also be maintained. Knowledge evolves (Bartheleme, 1998) and so must be continuously updated. Updates to any source must ripple upward to the KMS. Maintenance is often performed by users, as in the Eureka system developed at Xerox (Wah, 1999). Maintenance may be compromised by new maintenance personnel (Zmud, 1999).

We believe that, except for lower communications costs, the benefits of knowledge management of passive knowledge should also be applicable to active KMSs, such as business rules, and that other benefits, such as improved verification, will result in improved business rule performance.

A CLIENT/SERVER ARCHITECTURE FOR ACTIVE KNOWLEDGE MANAGEMENT SYSTEMS

Client/server and specifically n-tier client/server permits the process layer software (written in C, Java, Visual Basic, COBOL, etc.) to interact with multiple data sources simultaneously. Since knowledge is located in so many data sources and housed in many data storage mediums, integrated source data presentation is extremely complex. If the knowledge is located in a departmental procedure, geographic information system, video and e-mail, the process layer must support the application program interfaces (APIs) to retrieve these four data sources and present them on a single workstation's display device.

Employing an n-tier client/server architecture will provide a flexible architecture for KMSs. The structure would be very similar to the three-tier client/server architecture detailed by Orfali, Harkey and Edwards (1999) which consists of a client tier, a middle tier (the slash – "/") and a server tier. An important consideration in the development of an architecture is support for varying levels of adoption. The proposed architecture allows an organization to begin with a passive KMS and then evolve through hybrid systems (where some activities are done as before, while other applications are migrated to the KT) into an active system.

The client tier would have at least the following: a GUI interface, a Web browser, the client operating system and any required client-side applications for KM (such as Lotus Notes).

The middle tier would contain a network operating system, and transport stack (such as TCP/IP) and service specific middleware for:
1. databases (such as ODBC, JDBC, and SQLJ),
2. Internet/intranets (such as HTTP and CGI),
3. e-mail (such as SMTP and POP3),
4. storing and accessing multimedia documents,
5. coordinating group conferencing,
6. linking individuals in group scheduling, and
7. workflow processes.

The server tier (database servers, knowledge servers, Web servers, etc.) would contain the server operating system and specific server-based applications such as database management systems, document management systems and server side groupware (such as the Lotus Domino server).

A KMS would normally reside on the knowledge layer (tier) and communicate with the client, middle and server layers (tiers) in an n-tier environment. Using the term *footprint* to mean the volume and location of users and applications that have access to the knowledge, the connectivity of the server(s) (network, Internet) will dictate the footprint of the knowledge. There are four possible KMS architectures: centralized, decentralized, distributed and hybrid.

The centralized architecture stores active and passive knowledge on a single knowledge server. The footprint of the knowledge is determined by the connectivity of the centralized knowledge server. This architecture is easily managed and consistency is enhanced, but it is subject to poor reliability from being dependent on a single server, may suffer from scalability or expandability problems and may incur high communications costs.

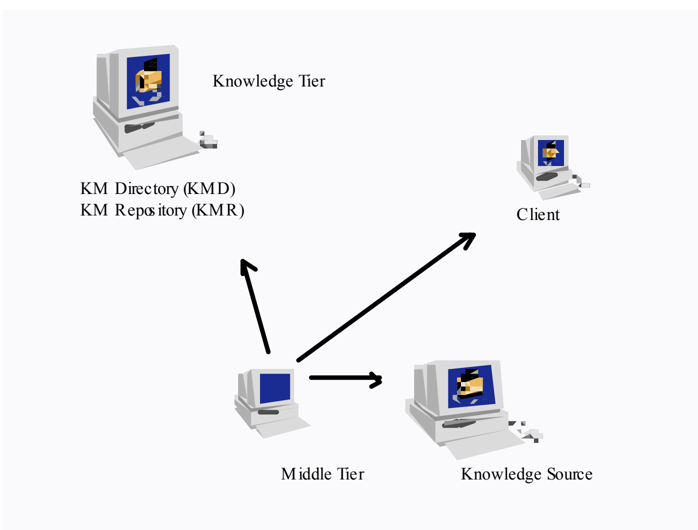
The decentralized architecture utilizes multiple knowledge servers that are not interconnected; the servers do not communicate or share knowledge. The footprint of each server dictates its reach. This architecture is good in reliability, as it depends only on the local server. It may suffer from scalability or expandability problems. It is easy to manage for local users and has low communications costs.

The distributed architecture stores knowledge on a local server closest to the use of the knowledge, and utilizes multiple knowledge servers that cooperate and share knowledge between servers. The footprint of the knowledge is the combined footprint of all of the knowledge servers, enabling massively parallel, cooperating knowledge servers. It is fair in reliability, as it depends only on the local server. It is expandable, as new sites are independent of others. It is easy to manage locally, but is complex to manage at the enterprise level. It has low communications costs, but may suffer from data inconsistency problems, especially if replication is employed.

The hybrid architecture shares knowledge from distributed knowledge sources and centralized knowledge, and enhances it with replication. Non-volatile knowledge may be widely replicated, lowering communications costs and increasing reliability. It is easily expandable. Replication can be difficult to manage and is subject to data inconsistency in volatile domains.

The decision to use a centralized, decentralized, distributed or hybrid architecture should be based more on organizational issues rather than technological issues. The decentralized, distributed and hybrid architectures, however, can be viewed as extensions of the centralized architecture because they implement multiple knowledge servers instead of implementing only one knowledge server. Thus, the remainder of this chapter will focus on the centralized architecture. The major architectural components of the centralized architecture are displayed in Figure 1, and this figure will be discussed both in a passive, as well as an active knowledge context.

Figure 1: Knowledge Management System Architecture



Passive KMS Implementation

A passive KMS implementation consists of the knowledge management repository (KMR) and the knowledge management dictionary (KMD). The KMR contains the stored knowledge for both active and passive components. The KMD is the user's gateway for locating specific knowledge in both active and passive knowledge components. The users are presented with hierarchical menus that allow them to drill down and locate knowledge components combined with a search function. A KMD could present some sort of list or picture of the available knowledge. The KMD points to (in people, documents or databases) but does not contain knowledge (Davenport et al., 1998). The KMD resolves the client request to connect to an information asset by translating the keyword into a data source location, permitting the customer to navigate the numerous information asset resources and locate the best match.

Referring back to Figure 1, the KMD would be employed to retrieve passive knowledge as follows:

Step 1: The knowledge requester issues an inquiry for knowledge.
Step 2: An inquiry is sent to the KT and a summary listing similar to an Internet search is presented.
Step 3: A second request is sent to retrieve the knowledge from the respective server.
Step 4: The knowledge is sent to the requester.

The Connect Intranet information system is a good example of a passive KMS that uses a centralized architecture. The system was created when British Petroleum (BP) and Amoco were merged in 1999. Connect is based on the simple concept of a directory of employee Web pages. Each participant develops a Web page containing information about themselves with links to associative information. The typical Web page includes the business unit name, past and present teams affiliations, recommend contacts, and internal and external Internet links. More than 12,000 employees are now listed in this voluntary directory.

The primary aim of Connect is to generate 10-minute telephone calls and/or e-mails that would provide the requester with sufficient knowledge to avoid reinventing the wheel. Connect was envisioned as an efficiency tool that would eliminate waste and save tens of thousands of dollars. BP Amoco estimates that it has one million man-years of experience embodied in its workforce.

Given a specific situation, for example drilling oil offshore in the Gulf of Mexico, an employee would search Connect using keyworks such as offshore drilling. All employee Web pages that contain a keywork search result equal to offshore drilling would be displayed. The knowledge searcher could then review each Web page and contact the author using the telephone or e-mail for additional information (Collison, 1999).

Active KMS Implementation

An active KMS would also contain a knowledge development environment and an inference engine. The development environment is used to capture and verify the knowledge from an expert and transpose it into an executable form. The inference engine takes data and uses formal logic to reason over business rules to determine an outcome. Data sources include users, application programs, database, Web servers and documents. Outcomes include tasks such as performing database activities, returning a value to a program or user, sending an e-mail and showing a Web page.

Referring back to Figure 1, active components use the KD in a very different manner. The KD records an inventory of active components, including characteristics such as the name, use and API for the component. Programmers will use the KD to determine how to use available knowledge components. Some active components may be called from inside application programs through their API, while others may be used as stand-alone applications. Active components may physically reside at a local or an enterprise level. The enterprise level components will physically reside on the knowledge server.

Step 1: The user accesses the KD.
Step 2: The KD displays a list of knowledge components and a search function.
Step 3a: The user may drill down the list of knowledge components and choose one by the name and description, or
Step 3b: The user may enter a search function, using keywords to locate the knowledge component.
Step 4a: If the knowledge component is an executable program, such as an expert system, the program is executed.
Step 4b: If the knowledge component is a shared program, such as a DLL, the user is presented with the API and instructions for the component.

An active knowledge component may be implemented at a local or an enterprise level. It may perform tasks in a continuous manner or in an on-call mode. It may be used by users or programs, and may operate in an automated or interactive mode.

Enterprise-level tasks execute continuously and are best suited to automated processes. For example, consider automating a nuclear power plant. There is a maximum acceptable temperature in the reactor. Sensors send temperature readings to the KT. The KT checks the KMD to see what knowledge processes use the input, and determine if the input's value requires further action. In this example, let us assume that a temperature of 240 degrees is input, and this value requires further action. Each knowledge process will use the Logic Engine to determine what outcomes are necessary. In a nuclear power plant, the outcomes might include sending signals to mechanical components to cool the reactor, making database entries to record the incident and sending e-mails to the appropriate personnel.

Knowledge processes are also available in an on-call basis. These processes may be automated or interactive. If complete data is available and the logic in the business rules is complete, processes may be automated. If the data is not complete or the business rules are incomplete, the logic engine may not be able to return a value. This is commonly understood to imply that no action is necessary, which may be the correct response. If the business rules have not been exhaustively verified, it may also indicate that a needed business rule is missing. If automation of this process is essential, one may employ default values (Cholewinski et al., 1999) or best-guess strategies, but one must be aware that both compromise accuracy.

Computer programs would access knowledge components through an API, invoking the logic engine with local data and receiving the output value. In this manner, knowledge applications may be performed transparently. In this environment, outcomes may be performed at the local level, enterprise level or both.

Interactive processes may be initiated by the user through the KMD. The process proceeds in the same manner as an expert system consultation, with the computer generating questions for the user and the user responding. The logic engine then reasons over the inputs and determines an outcome, which it displays to the user.

EXTENDING THE BASIC ARCHITECTURE

Accuracy is paramount in any automated system, but for less structured domains, the potential for catastrophe is much greater. A single bad business rule can cause disaster for the entire system. Automation of less structured problems is very different from structured domains. The logic in structured systems is fairly simple and can be easily verified, yet the logic in less structured domains is far more complex and cannot be easily verified. The need for tool-based verification or extensive manual verification is an essential task in developing and delivering active knowledge components. One survey described 145 verification tests for expert systems (Murrell & Plant, 1997).

By migrating the business rules and other knowledge components into a separate KT, we can provide a superior environment for the development, verification and implementation of business rules. In addition, the connectivity of a server in a client/server architecture ensures a wide availability of data, knowledge and control mechanisms.

We propose that the KT contains an active component representing business rules and other active components. In contrast to the passive components of a KT that supplies information, the active component performs tasks in response to changes in data or to external instructions. These tasks may include activities such as database transactions, sending e-mail, running an external program or triggering switches to change the operating characteristics of machinery. The active component of the KT should offer superior performance and accuracy because of the ability to computationally verify business rules and the access to the most accurate knowledge and data available to the firm. Both the commercial tool EZ-Xpert (Hicks, 1996) and research into active databases (Amghar et al., 2000) use a CASE approach to the verification of business rules.

CONCLUSIONS

In this chapter, we have proposed an architecture appropriate for active and passive knowledge components, and extensions to the concept of a KMS that allow the development, verification and delivery of intelligent components.

The n-tier client/server architecture, combined with the knowledge dictionary, allow the easy sharing of passive information assets. The segregation of active knowledge assets to the KT should offer less expensive development and maintenance, better verification and higher accuracy.

A dedicated knowledge development and delivery environment consisting of a knowledge acquisition system and an inference engine will allow the computerization of less structured domains with acceptable accuracy, allowing further automation and cost savings.

In conclusion, a KT of an n-tier client/server architecture provides a seamless integration of the variety of technologies required for a KMS, such as database management, document management, groupware and e-mail. In order to locate specific knowledge when the total amount of knowledge stored is so varied and large, a KMD that stores the specific locations of the knowledge is essential. Ensuring that this location data is correct is extremely important for the success of the KMS. Further, the identification of new knowledge should be an on-going process, as the KMD must be up to date to have value in a rapidly changing world.

We may leverage our implementations of passive knowledge management by including active knowledge. The KT is the most appropriate location for knowledge components in the enterprise architecture. The KT is connected to all of the significant knowledge assets in the company, providing the most reliable knowledge for use by knowledge components. This approach also enhances the potential for streamlining activities, automated verification and automating functions at the enterprise level.

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Chapter IX

Social Issues in Electronic Commerce: Implications for Policy Makers

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ABSTRACT

The revolutionary development of network technologies launched electronic commerce as a global phenomenon. Consequently, the policy issues that arise from its use create new responsibilities for policy makers worldwide. Apart from the technical (e.g., fast and reliable networks) and regulatory (e.g., legal frameworks and standardization) challenges that need to be tackled, there are a number of social concerns that also need consideration. It is important for policy makers to see Internet use and electronic commerce as a social as well as a technical phenomenon. In this chapter we examine how social

concerns such as trust and digital democracy pertain to all levels of Internet and electronic commerce policy, posing dilemmas and influencing the construction of an effective and socially responsible strategy for electronic commerce.

INTRODUCTION

Policy implementation for electronic commerce is a complex process since policy makers, national governments in their majority, have to act in a fast-changing environment. They need to balance special national demands with international cooperation (Papazafeiropoulou & Pouloudi, 2000). One of the areas that policy makers have to tackle—dealing with barriers—has been reported in the adoption of electric commerce today. These barriers are mostly derived from factors such as lack of awareness about the opportunities offered by electronic commerce as well as lack of trust to network security. Additionally the current legislative framework, drawn before the advent of electronic commerce, is perceived as outdated, thus impeding the expansion of on-line transactions. Policy makers, therefore, find it increasingly critical to update commerce legislation (Owens, 1999; Shim et al., 2000; The White House, 1999) and take other measures to facilitate the uptake of electronic commerce.

As the need for appropriate policy measures that support the information society is increasing, it is important to prevent a predominantly technical, commercial or legal approach that neglects the broader social issues related to policy making. To this end, this chapter examines social issues related to electronic commerce policy making and is structured as follows. In the next section we present two fundamental social concerns that are related to policy making in electronic commerce: trust and digital democracy. We then discuss these concerns in light of different policy issues arising from the use of network technologies, and present their implications for policy making in electronic commerce. The chapter concludes with the importance of a holistic approach to policy making and suggestions for further research.

SOCIAL CONCERNS

The introduction of technologies such as the Internet in everyday life has resulted in a debate about its relative merits and disadvantages. Some of the social concerns are illustrated in the study conducted by the Stanford Institute for the Quantitative Study for Society (SIQSS, 2000) concerning the social implications of Internet use. The findings of the study indicate that the Internet is an "isolating technology" that could seriously damage the social fabric of communities as users interact physically with other people less. The social implications of the Internet can be witnessed in organizational processes, the nature of work, learning and education, innovation and competition, electronic democracy, privacy and surveillance (Dutton, 1996). This section considers the social concerns related to the use of Internet technologies by focusing on two of the most frequently discussed social issues in electronic commerce. These are *trust*, a social issue underlying the business use of the Internet, and *digital democracy*, a term underlying the use of Internet technology in the society as a whole. The following paragraphs consider each in detail.

Trust

Lack of trust in on-line transactions is one of the main reasons reported for the relatively low electronic commerce adoption today. Trust is a key issue, and its existence among the business community and the end-consumers will increase the willingness of trading partners to expand their electronic transactions (e.g., Hart & Saunders, 1997; Miles & Snow, 1992; Ratnasingham, 1998; Wilson, 1997). The low level of trust in electronic commerce can be attributed partly to the lack of face-to-face interaction between trading partners in conjunction with the general uncertainty of users in taking advantage of network technologies (Ratnasingham, 1998). According to Johnston (1999), there are a number of actions that can be taken to respond to user uncertainty. First, users should be educated about privacy and security issues. Second, the necessary legislation framework that protects trading partners must be developed. Third, the perceptions about technology as a tool that can threaten trust, need to change to acknowledge that technology can also be applied for the users' protection, for example through the effective use of encryption mechanisms.

Digital Democracy

Information and communication technologies offer opportunities for governments and citizens to be brought into closer dialogue; they also facilitate political organization and debate (Raab et al., 1996). However, the extent to which the information superhighway can fully enable citizens to participate in this emerging "digital democracy" has been heavily debated. First, at a conceptual level, our understanding of democracy is "as bounded in time as it is rooted in space" (Nguyen & Alexander, 1996, p. 120), which means that the term digital democracy is inherently problematic in "cyberspace." Importantly, there is a concern that if citizens are not able to have access to on-line services, because they do not have the means or the knowledge to do so, existing patterns of inequalities will be reinforced.

The digital democracy is threatened by "information aristocracy" (Carter, 1997). In particular, there is evidence of a gender and race gap in the use of Internet, as well as differences for users with different levels of income and education (Hoffman & Novak, 1999; Kouzmin et al., 1999). While policy makers at an international level are concerned about access to electronic commerce, the burden falls mostly upon local authorities, who are responsible for the provision of access to network facilities through the use of public access centers, kiosks or tele-working centers.

At a global level, the penetration of electronic commerce in developing countries is also an outstanding issue related to the "haves" and "have-nots" in cyberspace, (e.g., Bhatnagar, 1997; Blanning et al., 1997; Clark & Lai, 1998; Kim & Hong, 1997). Easy global information access, however, is also problematic as it has been described as threatening both cultural identity and the regulatory sovereignty of the state, especially when used in less powerful economies (Shields, 1996). Finally, as privacy protection is a major concern in electronic commerce, there is a concern about whether "cyberspace" can promote democracy while protecting privacy. The free information flow of democracy and the users' need to control the flow of personal data can be seen as zero-sum alternatives that may (or may not) be balanced (Raab, 1997). This generates several policy dilemmas, which are reviewed in the following sections.

EMERGENT POLICY ISSUES

The Internet is the most popular means for the implementation of electronic commerce systems. Its fast expansion in the last decade was exceptional, forcing policy makers to speed up their efforts for its governance and regulation. The policy issues described in this section have to be addressed in order to facilitate the development of a safe and well-defined environment for electronic commerce, addressing the social concerns outlined in the previous section. These policy issues are presented following the six levels of Internet policy architecture, including infrastructure, governance, security, privacy, content and commerce. These have been defined by the Global Internet Project (GIP), a group of senior executives from leading companies around the world (Patrick, 1999; www.gip.org). The second part of the section presents the dilemmas in addressing policy issues, leading on to a discussion of the implications for policy makers in the remainder of the chapter.

Policy Issues at Six Levels of Internet Policy

Infrastructure

The infrastructure level aims at addressing "the challenge of meeting the demand for reliable and scaleable access to the Internet" (Patrick, 1999, p. 106). The speed, the quality, the reliability and the cost of the networks used for on-line transactions are very important factors that can either boost or obstruct evolution of electronic commerce. One of the top priorities of governments is the support of the telecommunications industry so that it can offer better quality services in terms of speed, reliability, continuous access and interconnectivity between sub-networks (Patrick, 1999). The American government, for example, aims at the provision of on-line services to the majority of the American households, not only through desktop computers connecting to the Internet, but also through devices such as television, cellular phones and portable digital assistants (U.S. Department of Commerce, 1998). The liberalization of the telecommunication market is a relevant directive of the European Union (EC, 1997) and OECD (OECD, 1997b) to their member states. It demonstrates the intention of international policy making organizations to reduce the cost and improve the robustness of the telecommunication infrastructure world-wide.

In relation to the social concerns discussed in the previous section, policies that support the infrastructure level contribute towards better *trust* in terms of Internet performance. The availability of appropriate infrastructure and the capability to access it, however, as a prerequisite for the *digital democracy*, are contingent on the resources available within a particular region or country. Thus, global coverage is a major concern for policy makers today (Hudson, 1999). Within a national context, the quality of the telecommunication infrastructure in rural areas is particularly significant, when the accessibility to alternative means of obtaining information is very limited. Overall, as the role of the nation state declines in providing access to telecommunications networks, it may be up to independent bodies to support citizens gaining access to Internet-delivered services (Keenan & Trotter, 1999). At an international level, also, it may be up to independent bodies and international organizations to facilitate the development of Internet and technological infrastructure in developing countries. National governments also take initiatives to improve the take up and use of information technologies, but they do not always succeed (e.g., Walsham, 1999).

Governance

The Internet is characterized by its ability to expand without central governance. The Internet is the 'place' where the free economy can blossom, and this presents immense opportunities for electronic commerce. It is the intention of the policy makers at an international level to support industry leadership and self-regulation for electronic commerce (The White House, 1999; EC, 1997; OECD, 1997b). Specifically, there is a tendency to minimize government involvement and avoid unnecessary restrictions on electronic commerce.

However, as electronic commerce use becomes mature, its international nature creates the need for global governance in certain areas. For example, several legal cases have been reported that involved website owners and consumers or other companies. The conflict usually derives from the lack of certainty about where a Web company is physically located and thus under which country's legal system the company works (Aalberts & Townsend, 1998). Taxation is a specific concern for companies that intend to invest in new technologies and for governments that want to control electronic commerce similarly to traditional commerce. There is a wide range of proposals concerning the administration of taxes in electronic commerce (Johnston, 1999; Owens, 1999).

At one extreme there was the idea of absolute "tax-free" electronic commerce that had been implemented for transactions taking place among U.S. states until February 1998, when the U.S. public administration reaffirmed its commitment to making cyberspace a free-trade zone (Negroponte, 1999). At the other end there are proposals for introduction of special new taxes for electronic commerce. OECD (1997a) proposes an intermediate solution, directing its members to apply existing tax principles in electronic transactions. OECD, in cooperation with the European Union, the World's Customs Organization and the business community, has defined a set of framework conditions to govern the taxation of electronic commerce. These are neutrality, effectiveness and fairness, certainty and simplicity, efficiency and flexibility, factors that are naturally important to traditional commerce as well. Thus it is necessary to define the "rules" that govern electronic commerce and ensure that regulations can be enforced.

Overall, the governance level of Internet policy presents a challenge for national policy makers as they realize it is difficult, if not impossible, to control electronic transactions. Also, it is debatable what is within a specific jurisdiction or how "net laws" will be enforced or who will pay for enforcement (Shim et al., 2000). Additionally, policy makers are also keen to promote electronic commerce with minimal intervention, as they want to attract investors that will contribute to economic growth. North American countries, the European Union and Japan, for example, have realized that it is in their best interest to collaborate in order to create market conditions of *trust*. However, the interests of specific countries may at times prevail, and the compromises reached may be at a cost for *digital democracy*. A characteristic example is the difference between European and American provisions for personal data protection and its impact on electronic transactions between the two areas. This issue is addressed in further detail at the security and privacy levels in the next paragraphs.

Security

Network security and especially Web security is one of the most sensitive issues identified in the electronic commerce literature (e.g., Crocker, 1996; Kosiur, 1997; Liddy, 1996). A recent survey of Australian firms (Dinnie, 1999), "among the world's earliest adopters" of electronic commerce, reports that network security is a continuing concern and companies are more concerned about external threats. The survey reports that "16% of firms have suffered, or believe they may have suffered, at least one break-in via the Internet" (p. 112). Despite their perceptions of external threats, however, 30% of businesses admitted that their organization had no formal information security policy. More generally, the anxiety about security is expected to increase in coming years as Web-based applications are increasingly used for financial transactions. As the number of computers, networks, data and information multiply every day, the need for better security practices that protect information systems from malicious attacks, and at the same time preserve the civil liberties, will increase in the future (Hurley, 1999).

Cryptography is put forward as a powerful technological solution to network fraud. At an international level it can be applied with the collaboration of governments, the business community and trusted third parties (Denning, 1996). The required use of public and private keys in cryptography methods raises several public policy issues surrounding the encryption of data and who should hold the keys that unlock the encrypted information (Patrick, 1999; Pouloudi, 1997). Policy makers can play an important role in the implementation of a security policy, acting as trusted third parties or defining the legal framework for such organizations (Froomkin, 1996). There are multiple models concerning the role of governments in security policy. At one extreme, public authorities may have ultimate access to information, and at the other, they may leave the responsibility for security of the data to the information owner (Patrick, 1999). What seems to be urgently required today is better education and awareness of security of information systems and good security practices for companies and individuals (Hurley, 1999).

Privacy

Computer technologies like the Internet facilitate the exchange of personal information that can be collected, aggregated and sold across the world. As companies can easily take advantage of personal information that becomes accessible on information networks, e.g., through direct marketing (Wang et al., 1998), several issues are at stake. The most important concern is whether information is collected, aggregated or sold with the individual's explicit concern. There are several private organizations — Better Business Bureau OnLine (BBBOnLine), Worldwide Web Consortium (W3C), TRUSTe — that try to address the issue by giving a privacy "seal" to websites that are fulfilling some set criteria of privacy protection. These include the responsibility to make visitors to websites aware of what data is collected and giving them choice about making this data available to third parties. The TRUSTe White Paper (http://www.truste.org/about/about_wp.html) also emphasizes that websites bearing their Privacy Seal "must provide reasonable security to protect the data that is collected." Security is seen as the technological aspect of the broader social issues that are related to privacy.

Privacy is particularly important for the protection of sensitive personal data such as medical records, credit records, government data and personal data about children. The U.S. government has taken an untied regulatory approach to protect such information. In other words the aim is to enable Internet users to choose for themselves what level of privacy protection they want (Nelson, 1999). In Europe, in contrast, data protection is stricter and has been articulated at a pan-European level (Allaert & Barber, 1998). In the United States, the EU directive (EC, 1992) has been perceived as being overprotecting for European companies, raising barriers to the free exchange of electronic data between Europe and other countries (Swire & Litan, 1998). Indeed, the European directive on data protection challenged electronic transactions and data exchanges internationally, as it banned the export of personal data from the EU to those countries without strict federal data protection laws. This included the U.S., and resulted in severe trade disputes at an international level, which has been resolved recently with the Safe Harbor Privacy Arrangement. This is a mechanism which, through an exchange of documents, EU is able to certify that participating U.S. companies meet the EU requirements for adequate privacy protection. Participation in the safe harbor is voluntarily. Privacy advocates, however, argue that privacy is a profound and fundamental concept, hence "it merits extraordinary measures of protection and overt support" (Introna, 1997, p. 259).

The political nature of privacy is also evident within national boundaries, in particular in terms of the power that national regulators have: "what we should fear is the growth of government databases" (Singleton, 1998). Privacy therefore clearly raises social concerns in terms of *trust*, *digital democracy* as well as *employment*, particularly in relation to the rights of employers to access or monitor personal information of their employees (ranging from e-mail messages to medical records), often without their explicit consent or even their knowledge. Finally, the difficulties of updating databases and business processes, and the challenges to comply at a technical level when using some contemporary information technologies (Lycett & Pouloudi, 2001), signify that privacy protection remains a challenge for policy makers.

Content

As electronic commerce is an international phenomenon, it is impossible for policy makers to control the content of the information transferred on-line. While the exposure to all this information can be beneficial, for example expanding people's learning horizons (Forcheri et al., 2000), governments and citizens are concerned about the publication of offensive material (Nelson, 1999). As the complaints from parents and educators about the influence of the Internet on children become more frequent, there are several civil liberties organizations devoted to protecting users form exposure to inappropriate on-line material. Such groups include the Electronic Frontier Foundation (EFF), which supports legal and legislative action to protect the civil liberties of on-line users, and the Computer Professionals for Social Responsibility (CPSR), which aims to protect privacy and civil liberties. The World Wide Web Consortium (W3C) has developed a technical platform that allows user-defined, customized access to the Internet (Patrick, 1999; www.w3.organisation/PICS) and has enabled the creation of rating services and filtering software, for use by concerned parents.

While the need for filtering of some information is generally considered as appropriate, there are also attempts at censorship. For example certain Asian countries place restrictions on the use of the Internet. The use of censorship on the information highway is debatable, both in terms of its technological feasibility and also in terms of its moral foundation (Ebbs & Rheingold, 1997).

Other content-related issues in electronic commerce are the protection of copyright and intellectual property rights. The essence of copyright is to prevent the unauthorized copying, but works stored in a digital format can easily be copied or altered, while they can also be transmitted speedily through electronic networks (Brett, 1999). The practical problems that owners of digital data face are very important for governments trying to apply or extend existing copyright laws to digital means. At an international level the World Intellectual Property Organization (WIPO) facilitates the protection of property rights. According to its general director, Dr. Kamil Idris, the organization's aim is to ensure that "expertise is provided when laws or systems need upgrading to take into account novel areas of invention (such as providing protection for the fruits of genetic research) or of medium (such as the Internet)." As with other policy issues, intellectual property involves multiple stakeholders with different interests (Radcliffe, 1999), which makes it difficult to resolve at a global level.

Underlying the discussion in terms of content are also issues of *trust*, in terms of access to "suitable" material, but also in terms of authenticity and issues related to the concept *digital democracy*, depending on who, if any, decides what constitutes "suitable" material.

Commerce

Electronic commerce is at the top of the policy architecture pyramid of the Global Internet Project, as it is perceived to be a critical factor driving the growth of the Internet. Although electronic commerce has revolutionized the way of conducting business, it is still a business activity that has to conform to certain rules and work under specific standards (Negroponte, 1999). The European Union was the first official body that considered a supranational policy on electronic commerce, in its effort to advance the integration process and to create a single market (McGowan, 1998). However, there are several organizations working at a supranational level trying to enable global seamless communication such as the International Organization for Standardization (ISO) and the World Trade Organization (WTO). This is because standardization is recognized as an important issue in electronic commerce, since the establishment of EDI applications (e.g., Chatfield & Bjorn-Andersen, 1998; Faltch, 1998; Sokol, 1995; Tan, 1998).

Standardization, however, can be problematic, as it needs to balance multiple interests in an area where competition has international dimensions and differs considerably from traditional commerce. The extent to which certain stakeholders are privileged has an impact on the role of electronic commerce in facilitating the *digital democracy*. The importance of *trust* at this level cannot be understated, since, as discussed earlier, it is one of the main reasons why electronic commerce has not reached its current potential.

The discussion of the previous five levels of the policy architecture demonstrates that issues of trust are relevant at all levels, and indeed underpin the development and use of electronic commerce. The problem is that most of these policy issues are related to social concerns and cannot be easily resolved, as they bring about conflicts among stakeholder groups and policy dilemmas. These dilemmas are discussed in detail below in the context of electronic commerce policy making.

Dilemmas in Addressing Policy Issues

Previous research has argued that the policy objective of promoting deregulation and competition is in conflict with other policy priorities, in particular the desire to provide open networks and open access, and the aspiration to provide universal service to citizens (Graham, 1995). As electronic commerce expands, the dilemmas for the stakeholders of the information society increase. The review of policy issues at different levels in the previous section has revealed some of the dilemmas that policy makers face today:

- Should governments give priority to the protection of national identity and language or to international compliance?
- Should they promote their own interests or provide assistance to developing countries?
- Is governance about protection or restriction? (For example, at an individual level: is censorship desirable? At a business level: is taxation desirable?)
- Where should priority be given: to the protection of personal data or to competitiveness (to the extent that the free exchange of information and personal data supports electronic transactions and business practices)?
- What is more important, data and intellectual property protection or the free exchange of ideas and data?

These dilemmas relate to the appropriate use of regulation, although in some cases policy makers may have little choice as only some options are realistic (e.g., the Internet is used even though the legal context is unstable). Thus, one important observation is that some dilemmas may no longer be a matter of choice, particularly for less powerful stakeholders, such as individuals or governments of developing countries. A further observation is that in many cases these dilemmas imply *a conflict between the commercial and social interests of various stakeholder groups*. However, it is very difficult to draw some general conclusions about when either interest is at stake. Research in management (e.g., Pettigrew, 1985) and information systems (e.g., Walsham, 1993), as well as in law studies (e.g., as evident in the importance of case law), has stressed the importance of *context*. In "cyberspace" the context, whether temporal or spatial, is elusive, making policy making for electronic commerce more challenging. In view of these issues, the following section presents implications for policy makers, with emphasis on the policies that are relevant at the business and the societal level.

IMPLICATIONS FOR POLICY MAKERS

The challenge that policy makers face today in order to implement an efficient electronic commerce policy while addressing the dilemmas outlined above is twofold. Firstly, they need to provide the business community with a robust technical infrastructure and an efficient legislation framework. Secondly, they need to accommodate the social concerns rising from the use of electronic commerce, in order to create a "digital literate" society that will fully exploit the technology at hand while preserving their social interests and cultural identities.

A very important aspect of a national electronic commerce strategy is diffusion of knowledge about the business and society at large. Damsgaard and Lyytinen (1998) use, in their analysis on the diffusion of EDI (business-to-business electronic commerce), six government strategies defined by King et al. (1994). These are knowledge building, knowledge deployment, subsidy, mobilization, innovation directive and standard setting. We extend these strategies for the diffusion for electronic commerce, where apart from business individuals are also the targets of the government intervention. Thus, a grid can be created (see Table 1) with the combination of these strategies and their target groups (business, society).

Companies are usually the direct beneficiaries of electronic commerce policies. This is why all the diffusion strategies are applicable (see far right column in Table 1). Policy makers try to persuade enterprises to invest in new technologies and take advantage of the opportunities the new means can offer. The governments may use a great number of the strategies to influence companies and help them in the implementation of electronic commerce technologies and practices. Companies can first be made aware of the new technologies (*knowledge deployment*), receive financial support for investing on new technologies (*subsidy*), be encouraged to use technology in the "best way" (*mobilization*), be provided with examples of electronic commerce use (*information directive*) and finally follow standards (*regulation setting*). This part of the electronic commerce diffusion practice is related to technical and commercial aspects which, as we will explain in the next paragraph, can be conflicting with social issues.

Individuals acting as consumers (such as customers of virtual stores) or citizens (such as users of on-line government services) are in need of information. Governments can use traditional means such as the media to make their wide audience aware about the usefulness of the new medium and build confidence in electronic commerce transactions. *Knowledge deployment* and *mobilization* are the strategies that can best fit government's intention to create awareness about

Table 1: Target Groups of an Electronic Commerce Strategy

Policies	Individuals - Societal level	Companies - Business level
Knowledge building	✔	✔
Knowledge deployment	✔	✔
Subsidy		✔
Mobilization		✔
Innovation directive		✔
Standard/regulation setting		✔

electronic commerce, as well as about the rights of individuals in this new environment. Issues such as awareness about privacy protection and trust to electronic means should be considered by policy makers when they apply knowledge building and deployment practices. The education of the public on one hand can help the electronic commerce marketplace to reach a critical mass of users. On the other hand a "digital literate" society can use electronic means to perform "electronic activism" and express disappointment about business practices (see, for example, Badaracco & Useem, 1997). Additionally, they might refuse the exchange of personal data through electronic means, although this is a practice that is very useful to companies for marketing purposes. Thus, regulators should balance the needs of the business community with the social concerns related to the use of electronic means. It is expected that when the social issues such as trust and digital democracy are addressed satisfactorily, electronic commerce is more likely to become the predominant business practice.

The "education" of individuals within the business environment (business level) is essential. In this field the help of professional bodies such as chambers of commerce and trade associations is essential. While most of policy research concentrates on the role of governments or international organizations, the role of players, such as trade associations, that can act as policy intermediaries is very important: they have knowledge of the local context and thus can complement the general national or international policies.

As discussed earlier in the chapter, other policy intermediaries that become increasingly involved in policy issues in the information society include independent private organizations, as well as civil liberties and professional groups who wish to promote the interest of a particular group or the net-citizens at large. Schools and universities also face pressures to support the "workforce of the future" and try to promote the use of information and communication technologies, thus contributing to knowledge building and deployment strategies. Finally, the Internet empowers individuals to draw their own policies at a micro-level, e.g., choosing as parents which Internet sites they allow their children to access, deciding whether to make their personal information available and so on. While the Internet enables people as citizens and consumers to take action (e.g., Badaracco & Useem, 1997), people are not necessarily aware of the opportunities and risks of cyberspace or they may not have the power and access to make a difference, hence the importance of knowledge building and deployment strategies. Policy makers, whether local or national, government or private, need to recognize the prevalence and importance of social issues and encourage the debate for appropriate policymaking among stakeholders.

CONCLUSIONS

Policy makers have recognized the viability of electronic commerce and the opportunities it offers for business and citizens. While several ethical and security issues arise from the use of the new technologies, there is a general consensus that the benefits are substantial and justify the investment in electronic commerce. There are several efforts in this direction by policy makers at a national and international level. The chapter has argued that technology alone is not sufficient for the successful implementation of complex electronic commerce strategies, but the examination of social and political issues is crucial for a holistic approach on the subject. Indeed there are several dilemmas related to policy issues, making the role of the policy makers critical. We considered a general framework for policy making that could be used at a national or international level as a starting point for considering social issues in the context of electronic commerce strategies.

Further research in the area may include the investigation of electronic commerce policies implemented in different national settings and social environments since, in practice, different countries have different priorities. The case of developing countries would be of particular interest, as technical infrastructure and stakeholder awareness and involvement can be substantially different. Research also needs to be continued in specific areas that are affected by the extensive use of electronic commerce. Because of their social importance, of particular interest are the areas of health and education where issues of Internet use and electronic commerce become increasingly relevant (e.g., through tele-health or distance learning applications). A study of alternative national policies in these areas can lead to an informative debate about the underlying assumptions concerning the duties and social responsibility of policy makers towards different stakeholder groups.

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Chapter X

Information Technology Outsourcing in Australia

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ABSTRACT

In Australia, popular discussion of the growing market in outsourcing information technology (IT) has been spurred by decisions of several large companies and the Australian government to outsource IT operations, but there has been little academic research into outsourcing in Australia. This chapter reports research into Australian IT outsourcing based on data collected in 1999. The research objectives were to measure the incidence of outsourcing among Australian firms, identify the functions outsourced, the *reasons why managers considered outsourcing, the costs and benefits of outsourcing, possible changes in modes of and motivations for outsourcing and factors that are associated with successful outsourcing arrangements. The nature of and motivations for outsourcing have evolved; for example, cost saving is not (if it ever was) the prime motivator. The three most important factors driving outsourcing in Australia are access to skills, improved service quality and increasing managers' ability to focus on core business activities. Decisions to outsource are weakly correlated with company size, but are not related to industry sectors. The factors most associated with successful IT outsourcing were the cultural match between the vendor and client, and the nature of the contractual arrangements—partnerships are more fruitful than rigidly interpreted black letter contracts. Outsourcing (not just of IT) is becoming increasingly popular; we suggest reasons for this and propose further research. The research used quantitative and qualitative data. A survey was used to collect data from 277 informants, and six interviews were used to explore managers' reasons for outsourcing and relate these to the success of outsourcing arrangements. Outsourcing of many business processes (not just IT) is becoming increasingly frequent in Australia. Where appropriate, themes are illustrated by outsourcing activities other than IT.*

IT OUTSOURCING IN AUSTRALIA

Information technology (IT) outsourcing is defined as passing ownership and control of IT functions previously performed in-house to outside contractors (Gupta & Gupta, 1992; Willcocks, Fitzgerald & Fenny, 1995). The definition should be extended to IT functions not previously performed in-house. In-house processing and "pure" outsourcing are two extremes of a spectrum of possible arrangements whose middle point is perhaps joint ownership of an entity providing IT services (Lacity & Willcocks, 2001, pp. 18-32). IT outsourcing can be comprehensive (two major Australian banks have recently decided to outsource all their IT functions) or partial (e.g., share registries or payrolls). The vendor (hereafter the outsourcer and outsourcee are respectively referred to as vendor and client) may be an independent entity or a wholly owned subsidiary. The IT outsourcing decision can be simple or complex: a small organization might choose to outsource a payroll application simply to reduce costs. IT outsourcing decisions can be complex because IT applications tend to be integrated with each other, permeate the firm and touch most activities performed; it may be difficult to outsource a single application. The criteria used to evaluate outsourcing decisions may be multidimensional and intangible; besides difficult to estimate cost savings, the firm must consider intangible effects such as freeing up managerial time and possible dependence on the vendor.

The incidence of IT outsourcing is increasing in Australia; this is exemplified by outsourcing decisions made by the Australian Federal Government (Beer, 1999), AMP Insurance (McFarlan & Nolan, 1995), Ansett Australia, Mercantile Mutual (Howarth, 1999) and three large banks (Commonwealth Bank of Australia, Westpac and Colonial) (King, 1998). In 1998 the Australian government decided to force its departments to outsource their IT requirements. This initiative failed (Connors, 2001; Martin, 2001); the suppliers did not meet the users' requirements, the costs were excessive and the initiative was at least temporarily abandoned.

IT outsourcing is a growing Australian industry; Robertson (2001) opines that "revenue from the Australian [IT] outsourcing market was $A1.3 billion in 1997, and projections to 2004 will push it up to $A5.3 billion, or an average growth rate of 16%." Macrae (2002, pp. 45-46) reports forecasts of global outsourcing growth of 20%, the Pacific Rim outsourcing market being $A51B in 2005 and the Australian IT outsourcing market being $A5.1B in 2005 (a growth rate of 12%). Strassmann (1997) reports that the global IT outsourcing market was $US76B. Robertson notes that a few big vendors dominate Australian IT outsourcing.

We were unable to discover any academic research on Australian IT outsourcing. The only studies available have been those of consulting firms and vendors (Cullen, Seddon & Willcocks, 2001; Hurley & Costa, 2001). Loh & Venkatraman (1992b) seminally studied outsourcing decisions before and after Eastman Kodak's landmark decision to outsource, finding that adoption of IT outsourcing is motivated more by internal forces and imitative behavior than by external influences on organizations. Internal influences became more dominant after Eastman Kodak's outsourcing decision. A list of better publications giving general analyses of outsourcing would certainly include Lacity and Willcocks (2001), Quinn and Hilmer (1999), Bettis and Bradley et al. (1992) (who stress the strategic dangers of dependency and ceding learning opportunities) and Strassmann (1997, part V). Many writers have proposed research frameworks (Finlay & King, 1999), criteria (Edwards, 1998) and schemes for analyzing or assessing outsourcing (Bazinet, Kahn & Smith, 1998). Venkatraman (1997) provides a methodology for deciding what IT activities to outsource. The myriad popular reports of firms adopting or abandoning outsourcing are exemplified by Caldwell (1999) and Guy (2000).

REASONS FOR OUTSOURCING

We consider hypothesized advantages and disadvantages of outsourcing IT, noting some less rational influences and associated risks. Earl (1996; 1989, Table 8.2, p. 170) properly emphasizes the importance of considering intangible and tangible criteria in major business decisions.

Although most writers approve of IT outsourcing, Strassmann (1997, Part V) is salutary. He likens the mindsets of those to use it (and downsizing) to anorexia nervosa and outsourcing to a emetic. IT departments, repositories of vital knowledge and skills, contain essential human talent that will be demoralized by outsourcing. Drawing on Brynjolfsson and Hitt (1995), he finds that, although financial markets reacted favorably to outsourcing decisions, outsourcing 60% or more of an IT budget is a symptom of financial trouble.

Advantages

Reduced IT Costs

Outsourcing reputedly reduces IT costs. Vendors tempt firms by purporting to cut costs by 10% to 50% (Lacity & Hirschheim, 1993, p. 74). However, such figures may represent short-term savings or budget manipulations such as taking activities off balance sheets (Lacity & Hirschheim, 1993). The costs of developing, maintaining and running an application should be differentiated. By having expertise and up-to-date software and hardware, a vendor may be able to build, maintain and/or run an application more cheaply than can be done in-house (Benko, 1992; Collins & Millen, 1995; Currie & Willcocks, 1998; Lacity & Willcocks, 1998; Lacity, Willcocks & Feeny, 1996; Loh & Venkatraman, 1992a; McFarlan & Nolan, 1995; Willcocks et al., 1995). Economies of scale can lower costs; a vendor can supply, run and update the software needed for a common application — classically payroll and share registries (Benko, 1992; Currie & Willcocks, 1998) — and distribute the development, maintenance and running costs over many clients. McFarlan and Nolan (1995, p. 12) and Davey and Allgood (2002) allude to accessing lower labor costs through international outsourcing.

Risk Avoidance

By purchasing services at a fixed cost per transaction, a client can avoid financial uncertainty. A firm may prefer to contract out transaction processing or aspects of systems development at an agreed price rather than try to ascertain in-house costs, cope with their variations or expose itself to possible disruptions of its own system; the firm buys insurance from the vendor. A corollary is that the vendor's incompetence may disrupt its client's business (Benko, 1993). Quinn and

Hilmer (1994) note that the vendor will conceal knowledge of potential disruptions to service such as possible insolvency. Kern, Willcocks et al. (2002) describe the "winner's curse": successful bidders for outsourcing contracts stretch and promise more than they can deliver.

Concentration on Core Activities and Competencies

Outsourcing allows managers who feel unable to competently manage an IT function to concentrate on core businesses. It is rational for managers to thereby exploit competencies based on their experience and knowledge, contract out activities in which they are less competent and benefit from vendors' expertise. Vendors claim they can supply expertise and state-of-the-art technology (Benko, 1993), eliminate problems associated with technological obsolescence (Gupta & Gupta, 1992), and increase the flexibility and quality of IT services (Antonucci, Lordi & Tucker, 1998). Vendors generally promise to manage the functions that cannot add value internally, allowing management to focus on central strategic business issues (Benson & Ieronimo, 1996; Caldwell & McGee, 1998; DiRomualdo & Gurbaxani, 1998; Lacity et al., 1996; McFarlan & Nolan, 1995; Pralahad & Hamel, 1990; Willcocks et al., 1995).

Avoidance of Cultural Problems

An effective IT department may have to have a culture different from the rest of the organization. Effective systems analysts must be willing to dispute managerial fiats and make suggestions that threaten jobs and hallowed assumptions. Friction may arise because young and articulate computer staff enjoy working conditions and salaries better than those in the rest of the organization. Outsourcing may ameliorate these problems: "Cultural differences can also often cause friction between IT and management" (Williamson, 1997); outsourcing may allow the "elimination of an internal irritant" (McFarlan & Nolan, 1995, p. 14).

Disadvantages and Risks

Loss of Flexibility

Signing a three-year outsourcing contract lessens flexibility. If business requirements change, or changes in information technology create new opportunities or lower prices, then the client has to renegotiate the contract in order to access them. If IT had not been outsourced, change could have been affected by managerial fiat. Before signing, the client must carefully estimate its next three years' requirements, an inexact and often costly exercise.

The Relationship

An outsourcing relationship can be characterized as either arm's length or collaborative. The former is appropriate when the services and quality attributes (turnaround time, unit price and accuracy) can be unambiguously defined, and is most likely to arise in simple transaction processing. When the task cannot be neatly defined, a cooperative or partnership relationship will be required. This is best exemplified by a vendor developing a computer system (Davey & Allgood, 2002, pp. 14-15): it is nearly impossible to precisely specify all requirements in advance; the vendor learns about the client's business and the client learns about IT's potential and its application to the business. Both parties' employees exchange knowledge and information in a thousand conversations. The relationship will be most fruitful when both parties share the benefits of an improved business process (but see the section, *Partnering*).

Problems may arise when the parties have different expectations: the vendor treats the relationship as "cash and carry," but the client expects continuing support and involvement. Some vendors are all cooperation until the contract has been signed, but then take a severely legalistic view.

Loss of Distinctive Competencies

Quinn and Hilmer (1994) and Bettis, Bradley et al. (1992, pp. 14-17) stress that outsourcing the intellectual or other skills underlying a distinctive competence may be bad strategy. A bank that outsources the development of software driving its automatic telling machines (ATMs) may advantage competitors or create new competitors because the skills and knowledge accumulated by the contractor are applicable to the development of a competitor's similar system. Although confidentiality agreements prevent code written for one bank being copied into another bank's application, the experience gained will make developing the second bank's application much easier and quicker. If the vendor's employees disperse, it may be difficult for the first bank to enforce confidentiality.

The bank may become dependent on the vendor (Earl, 1989); it may be impossible to re-create in-house outsourced knowledge and skills (Bettis et al., 1992), thus allowing the vendor to use its monopoly power to demand a high price for changes, such as making the system Y2K compliant in the late '90s (McFarlan & Nolan, 1995). It may be impossible to keep some commercial secrets from a vendor intimately involved in core activities, and the vendor may be able to identify and recruit its client's best IT staff.

When information technology is a critical success factor, it should be treated as a core competency and retained in-house. Thus, banks should not outsource the development of software driving automated telling machines (ATMs) or software underpinning customer relationship management. To do so makes the bank dependent on vendors and, more importantly, gives vendors learning opportunities that might be used to develop products useful to clients' competitors. Bettis, Bradley et al. (1992, p. 13) give examples of companies outsourcing the supply of apparently trivial components. The vendor used this opportunity to learn about and eventually enter the business. It is extremely difficult to prevent a supplier from learning about the client's market. Strassmann (1997) notes a case in which a bank prudently passed encrypted data to its vendor.

Serendipitous ideas for systems improvement might arise from salespeople's, systems analysts' and accountants' informal conversations. If the IT function is outsourced, such opportunities may not arise, although conversations with expert outsourcers may be fruitful.

Change Problems

Outsourcing creates change problems. If an in-house system is replaced by a vendor's system, there is some danger of disruption caused by misunderstanding or failure to transfer data properly. Employees may be irked because the new system requires that work be done differently. Outsourcing a function may entail dismissal or redeployment of employees, changes in the work they do, or their transfer to the vendor's employment and its different conditions (Antonucci et al., 1998; Caldwell & McGee, 1996; Useem & Harder, 2000, p. 32). Australian law forbids attempts to reduce employees' working conditions by transferring them to a different employer (Macrae, 2002, p. 47).

Ascertaining Relevant Costs

It may be difficult to ascertain or quantify all costs and benefits relevant to an outsourcing decision. It is notoriously difficult to allocate the costs of internal IT among individual applications or to quantify the fixed and variable components (Quinn & Hilmer, 1994). Bettis, Bradley et al. (1992, p. 12) imply that the way in which overheads are distributed among activities may affect their apparent cost and thereby influence outsourcing decisions. Outsourcing a function requires overheads to be distributed among fewer activities.

Barthelemy (2001) lists "the hidden costs of IT outsourcing." The cost of coordination with an outside supplier may be greater than co-coordinating internal departments' activities (Hoffman, 1997), and some costs of change may be intangible. Clients may be ignorant of vendors' cost structures and thus find it difficult to ascertain whether they are paying excessive fees. Documenting internal operations being considered for outsourcing and preparing service level agreements (SLAs) (Sturm, Morris & Jander, 2000) may be a lengthy and expensive exercise.

Cultural Problems

Antonucci et al. (1998), Meyer (1999) and Tauhert (1997) emphasize the need for a cultural fit between the parties. Clark (1998) opines that "…equally important, the delivery team must understand and adapt to your organization's culture." Useem and Harder (2000, p. 26) suggest that outsourcing and partnering require changed skills of clients' managers. Instead of being directly responsible for operations, managers may become resource managers and have to develop skills in analysis of requirements, negotiation, preparation of SLAs and contracts, relationship management and change management.

Cultural difficulties may be more pronounced when outsourced tasks are performed in a different culture; Davey and Allgood (2002) describe a case in which a United Kingdom client outsourced the development of an information system to an Indian supplier. The difficulties inherent in precisely defining the work to be done and the standards to be met were exacerbated by cultural differences. Indians posted to the UK suffered culture shock, communication was impeded by differences in pronunciation and meaning, and Indians were unfamiliar with many business terms and concepts. Indians were used to a hierarchical culture: they found it difficult to say "no" and tended to defer to the project leader. It took time for both parties to get used to and work fruitfully with each other.

Other Factors

There may be other, ostensibly irrational, influences: the current Australian government has an ideological commitment to outsourcing, opining that the private sector is intrinsically more efficient than the public sector (Beer, 1999). Like TQM and BPR, outsourcing may be a managerial fad (Loh & Venkatraman, 1992a, p. 340; Shapiro, 1995) for which enthusiasm may fade. Outsourcing may be cosmetic, avoiding head-count limitations, converting a capital expenditure into a continuing expense or realizing cash by selling IT assets to the vendor.

METHODOLOGY

This study was motivated by three research questions:

1. What is the extent of IT outsourcing in Australia?
2. What factors persuade Australian organizations to outsource IT functions?
3. What factors contribute to successful IT outsourcing arrangements?

The instruments were a survey and six interviews of executives with outsourcing experience.

The Survey

The survey used (a copy of which is available from the authors) was developed and executed by a reputable management-consulting firm prior to the authors' involvement. It was neither validated nor based on a prior survey. The questionnaire was mailed to the CIO (Chief Information Officer) or CFO (Chief Financial Officer) of 3,000 Australian organizations. Reply-paid questionnaires with an explanatory cover letter, signed by a partner, were enclosed. The sample comprised subscribers to CIO and CFO magazines, supplemented by CIOs and CFOs of the consultant's clients. It is possible the CFO and CIO of the same organization both responded; 277 useable questionnaires were returned. The response rate is typical of surveys of Australian business, but there might be sampling bias; respondents not using outsourcing are probably less interested in replying.

The survey comprised questions on demographics, kinds of IT work outsourced and modes of outsourcing, use of and intent to use outsourcing, reasons for not outsourcing, value and duration of outsourcing contracts, anticipated and actual savings, objectives, selection process and ways in which the relationships were managed.

Interviews

The quantitative research was supplemented by semi-structured interviews with six senior executives, from the insurance, government, passenger transport, telecommunications and steel distribution industries, who had been involved in recent outsourcing decisions. This was a convenience sample selected by a partner from the clients with whom he was working, or had recently worked, on outsourcing projects. It is unlikely that champions of unsuccessful outsourcing projects would have been selected or that respondents are dispassionate observers. The interviews were useful in alerting the authors to issues of interest to management. Some of their comments, used to highlight and exemplify findings, are presented in the sections titled *Functions Outsourced and Vendors* and *Reasons for Using Outsourcing*.

Characteristics of Responding Organizations

Demographic details of the responding organizations are presented in Tables 1 through 5. Chi-squared tests show that the incidences of outsourcing and intent to outsource are not significantly related to industry sector, size (measured by annual revenue or number of employees), number of IT employees or the IT budget.

Discriminant analysis (DA) was used to determine whether there were significant demographic differences between (a) organizations that did or did not outsource, or between (b) organizations that do not now outsource but did or did not intend to outsource. The DA tests found that large organizations use outsourcing

Table 1: Organization's Primary Business and Outsourcing Intent

Primary business	Does your organization currently outsource IT?			Is your organization considering outsourcing IT?		
	Yes	No	Total	Yes	No	Total
Communication	6	4	10	3	1	4
Automotive	3	7	10	3	5	8
Food	5	2	7	2	2	4
Banking	6	3	9	2	2	4
Insurance	9	2	11	1	1	2
Resources	9	6	15	3	4	7
Service	53	39	92	14	28	42
Manufacturing	19	20	39	12	11	23
Government	44	20	64	13	9	22
Total	154	103	257	53	63	116

$\chi^2(8, N=257) = 10.801, p = .213$ (using outsourcing)
$\chi^2(8, N=119) = 6.265, p = .618$ (considering outsourcing)

Table 2: Sample by Annual Revenue and Outsourcing Intent

Annual revenue ($A Million)	Companies that outsource IT		Total	Companies that plan on outsourcing IT		Total
	yes	no		yes	no	
Less than 50	28	22	50	8	16	24
51-100	35	22	57	13	11	24
101-500	54	44	98	22	28	50
501-1000	24	7	31	4	5	9
More than 1000	22	10	32	7	5	12
Total	163	105	268	54	65	119

$\chi^2(4, N=268) = 6.269, p = .180$ (using outsourcing)
$\chi^2(4, N=119) = 3.007, p = .557$ (considering outsourcing)

Table 3: Sample by Number of Employees and Outsourcing Intent

Number of Employees	Companies that outsource IT		Total	Companies that plan on out-sourcing IT		Total
	yes	no		yes	no	
less than 50	3	3	6	1	2	3
51-100	4	3	7	1	2	3
101-500	45	43	88	16	31	47
501-1000	40	24	64	12	13	25
1001-2000	36	14	50	9	9	18
2001-3000	7	3	10	2	1	3
3001-4000	6	4	10	3	2	5
4001-5000	8	1	9	1	1	2
over 5000	11	4	15	6		6
Total	160	99	259	51	61	112

$\chi^2(8, N{=}259) = 10.812, p = .213$ (using outsourcing)
$\chi^2(8, N{=}112) = 11.224, p = .189$ (considering outsourcing)

more than small ones (p<0.005). In this context, the most important measure of size was the "annual spend on IT services"; firms with large IT budgets are more likely to outsource. This result must be viewed with caution: some assumptions underlying the statistical tests did not hold. Tests differentiating (of those firms not now using outsourcing) those who did and did not intend to outsource were not significant (p>0.05).

FUNCTIONS OUTSOURCED AND VENDORS

What Functions Are Outsourced?

The functions outsourced and the style of outsourcing are summarized in Table 6. Chi squared tests confirmed that there were very highly significant variations in the frequency with which various functions were performed in-house, $\chi^2(8, N{=}1702) = 253.3$, $p = .000$, and outsourced, $\chi^2(8, N = 1009) = 411.5$, $p = .000$. The

Table 4: Company Size by Number of IT Employees

	Companies that outsource IT			Companies that plan to outsource IT		
Number of Employees providing IT services	Yes	No	Total	Yes	No	Total
Less than 50	87	59	146	27	35	62
51-100	16	9	25	7	3	10
101-500	10	5	15	4	3	7
501-1000	2	0	2	0	0	0
1001-2000	3	2	5	1	1	2
2001-3000	3	0	3	1	0	1
3001-4000	0	1	1	0	1	1
over 5000	3	3	6	1	2	3
Total	124	79	203	41	45	86

$$\chi^2(7, N{=}203) = 5.491, p = .600 \text{(using outsourcing)}$$
$$\chi^2(6, N{=}86) = 4.933, p = .552 \text{(considering outsourcing)}$$

Table 5: Company Size by Spend on IT

Annual spend on IT services ($A)	Companies that outsource IT			Companies that plan to outsource IT		
	Yes	No	Total	Yes	No	Total
Less than 100k	1	2	3		2	2
100K-200K	5	7	12	2	6	8
200k-1M	35	29	64	15	19	34
1M-5M	68	45	113	20	27	47
5M-10M	21	12	33	8	6	14
More than $10M	33	8	41	8	4	12
Total	163	103	266	53	64	117

$$\chi^2(7, N = 226) = 10.615, p = .060 \text{(using outsourcing)}$$
$$\chi^2(6, N = 117) = 6.152, p = .292 \text{(considering outsourcing)}$$

Table 6: Functions Outsourced

Functions	Do not use	In-house	V[1]	V[2]	V[3]	V[4]	V[5]	V[6]	Total[7]
Asset management	22	224	11	8	1	14	0	13	43
Help Desk services	21	231	29	8	3	18	1	10	62
Data center operations	30	205	19	5	1	24	0	24	68
Analysis & Strategy	6	248	77	26	9	3	2	1	94
Desktop services	3	246	92	8	13	21	1	8	116
Others	6	40	18	1	0	7	0	1	24
Network services	2	232	112	22	13	24	1	16	153
Application development, implementation and maintenance	7	202	165	37	35	14	3	10	194
Hardware maintenance	3	70	157	43	6	44	3	26	255
Total	100	1702	680	158	81	169	11	109	1009

[1] Vendor / as-needed contractor arrangements
[2] Vendor / strategic services
[3] Vendor / project management
[4] Vendor / facility management
[5] Vendor / management buy-out
[6] Vendor / total outsourcing, including asset ownership of technology component
[7] Total using any form of IT outsourcing

functions in Table 6 are sequenced by the ratio of In-house to OS Total, for example, asset management and hardware maintenance are outsourced by 16% and 88% of respondents, respectively.

The sequence of functions in Table 6 is *roughly* consistent with the frequency with which these functions impinge on the organization's operations and with increased technicality. For example, help desk services and data center operations interact continually with other operations; they would usually be considered part of "core competency" (see Langfield-Smith, Stringer & Smith, 2000, p. 3, for definitions).

Nearly 40% of respondents have outsourced application development and maintenance (perhaps only a small proportion of core applications); in the past, few firms would have entrusted the development of internal applications to a third party.

Willcocks and Lacity (1998) opine that the tasks most closely related to business knowledge and sustaining competitive advantage cannot be effectively outsourced. This is supported by qualitative findings; an interviewee stated "the vendor does not know your business and industry as well as you do." The findings are consistent with previous research, indicating that telecommunication management, systems integration, application development and systems operation are the functions most likely to be outsourced (Teng, Cheon & Grover, 1995). Unlike Collins and Millen (1995), who report two cases of total outsourcing, we found 109 cases in which a function was totally outsourced; however, most IT functions (59%) are performed in-house.

The functions Australian organizations have outsourced are consistent with the trend toward selective outsourcing (Earl, 1989; Willcocks et al., 1995; Willcocks & Kern, 1998). It may be appropriate to outsource mundane aspects of a function such as a call center, but to develop in-house and keep secret those aspects (e.g., the scripts operators follow and interfaces with the firm's databases) that give competitive advantage and/or contribute to the company's public image.

The most common outsourcing arrangement is "as-needed contractual." This suggests that one-off tasks, perhaps requiring special expertise or software, are often outsourced. "Strategic services" and "facilities management" are also relatively popular. Anecdotal evidence suggests that these two arrangements may be exemplified by call centers operated by a vendor on behalf of a firm. For a modest-sized firm especially, there may be several advantages to outsourcing call center requirements. The call center operator may: have expertise in preparing scripts, selecting and training operators; be able to spread costs of hardware, software and facilities over several customers; be able to exploit economies of scale, in particular by evening load by operating across several time zones.

Multiple discriminant analysis of the six most commonly outsourced functions in Table 6 was used to determine whether outsourcing of any service area could be explained by the demographic variables measuring firm size or the kind of function, but no significant results were found ($p>0.05$).

Reasons for Using Outsourcing

The survey nominated nine possible reasons for outsourcing and asked respondents to characterize the actual and anticipated benefits as low, medium or high (coded as 1, 2, 3, respectively); the responses are summarized in Table 7. Anticipated benefits significantly exceeded actual benefits ($p<0.001$ in all cases). Table 7 can (despite the different questions and coding) be compared with Table 4 in Collins and Millen (1995). Comparative comments and Collin's rankings are given in Table 7.

Table 7: Anticipated and Actual Objectives (Ranked)

Rank based on Anticipated benefits.	Objective	Comparison with Collins Millen, 1995, Table 4	Mean (antic-ipated)	Mean (actual)
1	Access to skills	May be correlated with personnel cost savings (2)	2.65	2.27
2	Improved service quality	Synonymous (3)	2.48	2.06
3	Focus on core business	Synonymous (1)	2.34	1.97
4	Defined service levels	An aspect of improved quality of IS services (3)	2.34	1.89
5	Additional flexibility	Synonymous (4)	2.31	1.94
6	Access to technology	Synonymous (5)	2.25	1.98
7	Improved performance	An aspect of improved quality of IS services (3)	2.29	1.84
8	Cost savings	Reflected by Personnel cost saving (2); Technology cost saving (8) Stabilise IS costs (7)	1.89	1.64
9	Change fixed cost basis		1.72	1.52

There seems to be a quite high rank correlation between the highest five ranking items of both studies. The most striking difference is that Australian respondents did not place as much emphasis on cost savings.

We attempted to relate the benefits listed in Table 7 to organizational size and other factors such as the way the way the relationship is managed and the size and

Table 8: Motives for Outsourcing

- Political emphasis on downsizing
- Access to skills (high turnover, training costs, pays below market rates)
- Eliminate service delivery of functions that are not viewed as core
- Simultaneously achieve cost effectiveness
- Eliminate HR issues (high turnover, training costs, pays below market rates)
- Relatively new organization
- Quick and less expensive way to provide IT services
- As a start up company, couldn't afford the capital investment to reach level of expertise of vendor (needed core skills)
- Business does not have the desire to build/hire such talent internally
- Focus on core -- shift of resources
- Negative investment
- Cost saving operation
- Focus on the core business of IT department
- Shift of focus
- Free up management time
- Access to skills (in-house IT lacked necessary skills)
- HR issues (high turnover because of hierarchical structure, high training costs)
- Leverage economies of scale and provide improved service levels at a predictable cost

duration of the contract. The only reliable conclusion was that the actual "change in fixed cost basis" was positively related to organizational size ($p < 0.05$).

Some elaboration of these reasons was obtained in interviews with senior executives involved in outsourcing. Interviewees' verbatim reasons for outsourcing are given in Table 8. Some of their comments are included in the discussion of particular reasons for outsourcing. Similar findings were obtained in the KPMG/NNI Netherlands's study (Van der Zee, 1997).

Cost Savings

Many writers (Lacity & Willcocks, 1998; Loh & Venkatraman, 1992a; McFarlan & Nolan, 1995; Willcocks et al., 1995) stress cost savings as the dominant reason for outsourcing: "Widespread opinion exists that IT departments are increasingly unable to deliver anything useful on time and within budget...hence creating the need for organizations to consider the possibility of getting out of the data processing business" (Due, 1992, p. 80). Our findings are consistent with Collins and Millen (1995) and Grover and Cheon (1994) in finding that costs are a minor consideration in outsourcing decisions. Mullin (1996) suggests that the narrow perspective of cost reduction should not be the sole criterion for outsourcing decision. A summary of anticipated and actual cost savings is given in Table 9. Statistical analysis shows that anticipated (but not actual) savings are significantly above zero ($p<0.05$). There were no significant differences in actual savings among industries.

In our study the cost factors ranked 8/9 and 9/9 and there was a large gap between the means of the seventh and eighth ranked items; this very strongly indicates that costs are the last consideration in outsourcing decisions. Collins and Millen (1995) note that, among reasons for outsourcing, "personnel cost savings" ranked 2/10, but "stabilize IS costs" ranked 7/10. The former probably reflects accessing skills, the latter probably reflects managers' frustration in trying to predict and control IT costs.

Other effects of outsourcing listed in Table 8 are discussed in the context of interviews with managers.

Table 9: Cost Differential

Cost Differential consequent on outsourcing ($ Australian)	Anticipated achievements (Valid %)	Actual achievements (Valid %)
Higher total	12.0	24.6
No Savings	29.3	26.9
Savings less than 50K	20.7	17.9
Savings of 50K-250K	25.3	20.9
Savings of 250K-500K	4.7	3.0
Savings of 500K-2M	6.0	5.2
Savings of more than 2M	2.0	1.5

INTERVIEWEES' RESPONSES

We note that the number of interviews was small, that interviewees are unlikely to be extremely self-critical and are likely to remember and report selectively. However, the interviewees had good intellects, were frank and welcomed the chance to discuss issues with an outsider.

Cost Issues

The interviewees confirmed that cost savings were not the major driving force for outsourcing. They suggested that the desire to reduce costs is usually accompanied by another motive. What interviewees wanted (almost as much as reduced costs) were *predictable* costs. They may prefer in effect to pay an insurance premium by contracting to have a service provided at a fixed cost per transaction than to try to ascertain and control costs in their own IT departments. Typical comments were:

> *"...contract was fixed and costs will not increase"; and "Through outsourcing we sought to gain/leverage economies of scale and provide improved service levels* at a predictable cost. *Consequently, actual costs, on paper, tend to look higher with outsourcing. However, outsourced costs are predictable and, if contracts are well managed, unplanned events can be mitigated or responded to within the scope of the engagement. Therefore, if unplanned events are considered, outsource costs are actually less than non-outsourced costs."*

Change Fixed Cost Basis

Additional flexibility may reflect the time and expense required for a typical IT department to develop and meticulously test an IT system that meets an emerging business need and is integrated with the organization's other systems. In many cases it may be better to meet new IT needs by outsourcing. Even if the outsourced system does not exactly match business requirements, it can serve as a "strawman." (After working with a strawman — a trial system — staff can better express what they want a new computer system to do.) "Change fixed cost basis" reflects the ability to avoid paying a fixed cost by outsourcing.

Access to Skills

Interviewees were voluble on the difficulty of obtaining and retaining IT staff (the highest ranked item in the survey). The following quotes express the difficulties.

"...trouble retaining staff since they cannot compete with market rates for IT people and they remunerate between 15-18% below market rate." [We attract staff from] "the shallow end of the gene pool."

"High turnover of staff resulted in them being replaced with contractors at a significantly higher cost."

"The on-going need to train and re-train people as they left, preference for permanent resources."

"The company is not structured to provide a career path or reward scheme to attract and retain motivated technical professionals. What happens in this organization is: we hire people, we put them through Microsoft certification so they'll gain NT certification, at a cost of $A10,000. They generally stay for about six months, then they leave, because they can't move up."

Focus on Core Business

An interviewee opined that an objective of outsourcing was freeing up management resources to focus on core functions. The function outsourced in this case was not core and it did not exploit the company's strengths. Another interviewee, recognizing that his company lacked in-house skills, listed access to skills as a driving force. "In the past 10 years, the IT department was unable to deliver business value across such a broad range of competencies and number of disparate business units. We didn't have the necessary skills 'in-house' to deliver server excellence for application server support, WAN, LAN [and] desktop management." The company therefore sought to outsource IT infrastructure management activities. The motives of access to skills and wanting to focus on core business are exemplified by: "Since we do not currently have the skills in-house, the best we can do is replicate what a large vendor already has in place, and that is not the business we want to be in."

Reasons for Not Outsourcing

In contemporary Australia most IT functions are not outsourced. An interviewee eschewed IT outsourcing because IT has become a core concern — "IT and communications are close to the same thing now. We're one group of people." Interviewees opined that some critical IT functions, such as strategic planning, development of business-specific applications and IT support of critical systems, should remain in-house (Lacity, Hirschheim & Willcocks, 1994). "They require detailed business and industry knowledge."

Two companies outsourced critical IT functions. Company A's outsourced application was "highly mission-critical to the company. If the system goes off the air, we can't perform our function and many other stakeholders will be effected, as they all have the power to log on to the application." The application is based on outdated technology. "Consequently the vendor faces the challenge of a large overhead as they may encounter difficulty in recruiting young IT graduates that may not want to work with old technology."

A common view was that keeping abreast of IT changes is onerous and expensive. One interviewee stated that his company "had a political emphasis on downsizing and this was appropriately achieved by IT outsourcing. In hindsight, access to skills was another motive behind the decision to outsource."

Success Factors

The interviewees opined that some non-technical factors are associated with successful outsourcing arrangements. These are:

Contracts

All interviewees opined that successful outsourcing arrangements were based on "tight" contracts, i.e., contracts in which, as far as possible, the rights and responsibilities of both parties were explicit. Central to these contracts were service level agreements (SLAs) specifying turnaround and response times (Sturm et al., 2000). Saunders and Gebelt (1997, p. 72) opine that "companies with loose contracts viewed their outsourcing arrangement as a failure." A tight contract specifies penalties for non-performance and (possibly) bonuses. Interviewees' opinions on bonuses varied: "The penalty is losing the contract, the bonus is retaining it." In some cases, because the contractor was manifestly competent and cooperative, retrospectively unreasonable penalty clauses were not invoked.

Partnering

There is a spectrum of business relationships ranging from strictly arms length to highly integrated and cooperative. The former may be appropriate in commodity markets, the latter when companies comprise a consortium engaged on a common task such as software development. Although partnering is frequently discussed (Berendt, 1999; Fulcher, 1998) (specialization is the most commonly mentioned advantage), it is rarely defined. It may be an advantageous outcome of enriching an arm's length outsourcing relationship (Grover, Cheon & Teng, 1996; Willcocks & Lacity, 1998). Perhaps motivated by hoping to retain the business, the contractor may offer free services and/or advice. It may be impossible to get useful work done unless individuals at all levels of both organizations cooperate rather than point to legal obligations; legal contracts do not accommodate unforeseen events and technological changes.

Caution is appropriate: a lawyer opined: "Outsourcing agreements sometimes incorporate the notion of 'partnering.' Partnering is non-specific and legally ambiguous term. It is not unusual for the parties themselves to be unsure about what they are intending to achieve through a partnering arrangement. In broad terms, the goal seems to be *a spirit of cooperation which falls outside the contractual framework"*

Human Resource and Change Management

The interviewees were sensitive to the change and human resource problems that outsourcing may create. A new computer system may enrich, deskill, eliminate and/or create jobs. Outsourcing introduces new possibilities: some staff (probably IT) may have to transfer to a new employee, new conditions and/or a new location; they may have to adapt to a new culture. This may not be appreciated: "Some employees left because they didn't want us to select the employer they were going to work for." However, in a larger IT department, there may be more varied and challenging work, and more scope for specialization, training and promotion.

> *"The company considered subcontracting parts of the project or doing the entire replacement in-house, firing people as old systems went out of service. Ultimately, it decided to outsource the work to a company that promised to hire [our] employees."*

IT Management

The role of IT managers may change. Their prime responsibility may become the acquisition of appropriate IT resources (from internal or external sources) rather than managing the IT department's operations and projects. Even if the company outsources all its IT work, a small expert technical team will be required to formulate tenders, assess bids and monitor vendors' performances. A second responsibility is to stay abreast of changes in technology and business needs, to determine new possible business opportunities and apply IT to new business needs.

A vendor's systems will usually force changes in clients' procedures and functions (Gillis, 1997). If IT tasks are being contracted to an outsourcer, workers may lose "the informal channels sometimes used to get work in the pipeline" (Hann, 1996). Ptak and Noel (1998) note that clients should anticipate change and prepare their staff.

CONCLUSIONS

Outsourcing is a topic that has attracted predominantly favorable academic and commercial comment. Its supposed advantages ("sticking to knitting" and economies of scale) and disadvantages (dependency and loss of skills) are well known. Decisions as to whether to outsource some or all of a firm's information technology function can be difficult because the stakes are high, relevant costs difficult to ascertain and there may be strategic implications. Firms are reluctant to become dependent on a vendor by outsourcing a critical business process. They may be equally reluctant to have in-house a technology that is expensive, rapidly changing and hard to manage.

Many (perhaps 40%) of Australia firms use outsourcing for one or more applications. Although large firms tend to outsource more than small ones, this may be because they have more applications and there is a greater chance of at least one being outsourced.

The three most important reasons for outsourcing are access to skills, improved service quality and focus on core business. Cost was the least important reason. We infer that many firms find IT difficult to manage effectively and prefer to outsource it. An advantage is the ability to obtain IT services at predictable cost; managers are frustrated by their inability to predict or control internal IT costs.

A "tight" contract is a prerequisite to an effective outsourcing arrangement but, because business requirements constantly change, a measure of cooperation between the firm and vendor is essential. Unfortunately, in Australia at least, "partnering" has no legal basis. The most fruitful form of outsourcing is one in which both parties profit from improving the efficiency, effectiveness and scope of a business process.

Implementing an outsourcing arrangement is a change process that may affect employees. The CIO's role may change from managing internal projects and operations to acquiring and managing the internal and external resources required to do the firm's IT work.

The outsourcing of some functions once considered internal (cleaning, payroll, recruiting, legal work and security) is no longer remarkable. Communication technologies such as the World Wide Web (WWW), by making data transfer easy, quick and cheap, facilitate outsourcing data processing and office work. There are some circumstances in which outsourcing the development or running of IT systems is clearly appropriate.

Suggestions for Future Research

Business attitudes to outsourcing are changing. Originally seen as an ad hoc way of reducing costs or meeting transient demands, it is now regarded as a basic business technique. Especially as modern technology (manifest in electronic commerce) makes sharing data easy, cheap and fast, it may be appropriate for a business to identify, concentrate on, improve and exploit its core competencies and outsource everything else, thereby exploiting vendors' core competencies.

Changes to information and communications technologies imply that organizations will become less island-like and that managers must adapt to the relationships and boundaries between organizations becoming cooperative and permeable rather than contractual and rigid. The skills managers require will change: instead of instructing subordinates, they must negotiate with vendors or partners. We suspect that "insourcing" will become more popular and formalized. Insourcing means treating an internal supplier of services exactly as one would treat an external supplier. There is obvious merit in researching the appropriateness of different forms of relationships with other internal departments: commands structures or arm's length relationships are the ends of a spectrum of possibilities.

"Core competency" is a vaguely defined concept. The problems of identifying and exploiting an organization's core competencies merit research. A firm that outsources its call center requirements is ostensibly outsourcing a vital aspect of its customer relationship management (CRM). We detect a willingness to outsource the *mechanics* of a business process (for example customer relationship management), but to keep in-house "soft" aspects such as the scripts governing workers' interactions with customers.

Several other questions merit research:

1. What is the extent and growth of IT outsourcing in Australia? This chapter used organizations as the unit. When another survey is executed (on all forms of outsourcing, not just of IT), the unit of analysis will be a single outsourcing contract. This will allow clearer classification of outsourcing contracts. In particular we want to learn what kinds of function are most amenable to outsourcing and relate characteristics of outsourcing arrangements to their success.

   Particular questions are: Are IT outsourcing arrangements successful? Do they save money or give other tangible or intangible benefits? Do they break down and, if so, why? Is their success related to vendor selection (e.g., invitation or open tender), contractual arrangement (including service level specifications) and/or a "spirit of cooperation" between the parties?
2. Modern communications and IT (ICT) technologies have made the transfer of data between parties cheap, accurate and instantaneous. How much has this contributed to the growth of outsourcing and have outsourcing contracts that cross borders become more common? Can some countries' lower labor costs be successfully exploited despite cultural and language differences?

3. In Australia at least, contract law does not recognize "a spirit of cooperation." Does this hamper outsourcing arrangements and is there a case for the law to be changed, belatedly recognizing that, in a modern economy, corporate boundaries are permeable?
4. Outsourcing IT has consequences for clients' staff and IT departments. At present, IT managers are essentially managers of internal software production houses. They may become resource managers: planners and mere purchasers of IT resources. Outsourcing may change skill requirements, work and culture, and displace employees. The magnitude and management of such changes merit research.

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Chapter XI

Exploring the Influence of Rewards on Attitudes Towards Knowledge Sharing

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ABSTRACT

This study theoretically examines and empirically tests factors expected to affect an individual's knowledge sharing attitudes, intention and behavior in an organizational context. The research model is constructed based on the economic exchange theory, the social exchange theory, the self-efficacy theory and the theory of reasoned action. Results from the field survey of 467 employees of four large and government-invested organizations show that *'anticipated reciprocal relationships' and 'perceived personal contribution to the organization' are the major determinants of the individual's attitudes towards knowledge sharing. 'Anticipated extrinsic rewards,' believed by many as the most important motivating factor for knowledge sharing, are not significantly related to the attitudes towards knowledge sharing. As expected, positive attitudes towards knowledge sharing are found to lead to a positive intention to share knowledge and, finally, to actual knowledge sharing behaviors.*

INTRODUCTION

Among the processes of knowledge management such as creation, sharing, utilization and accumulation of knowledge, sharing is what differentiates organizational-level knowledge management from individual learning or knowledge acquisition. In fact, 94% of 260 responses from multi-national organizations in Europe believe that knowledge management requires people to share what they know with others in the organizations (Financial Times, 1999).

However, as Davenport (1997) argues, sharing knowledge is often unnatural. People will not share their knowledge, as they think their knowledge is valuable and important to themselves. Hoarding knowledge and looking suspiciously upon knowledge from others are the natural tendencies. In addition, these natural tendencies are difficult to change. In a study of 431 U.S. and European organizations, conducted in 1997 by the Ernst & Young Center for Business Innovation, the biggest difficulty in knowledge management was "changing people's behavior" (Ruggles, 1998).

Therefore, rather than just encouraging or mandating knowledge sharing, fostering the motivation to share knowledge must precede. The purposes of this research are to develop an understanding of the factors that support or constrain the individual's knowledge sharing behavior in an organization, and how those factors eventually influence knowledge sharing behavior. We propose 'anticipated extrinsic rewards,' 'anticipated reciprocal relationships' and 'perceived personal contribution to the organization' as the major determinants of the individual's knowledge sharing attitudes, and these attitudes as determinants of the intention to share knowledge. Then, we suggest that the knowledge sharing intention is an immediate predictor of the knowledge sharing behavior. The Theory of Reasoned Action (Fishbein & Ajzen, 1975) is adopted as the theoretical basis to explain how these determinants affect knowledge sharing behavior.

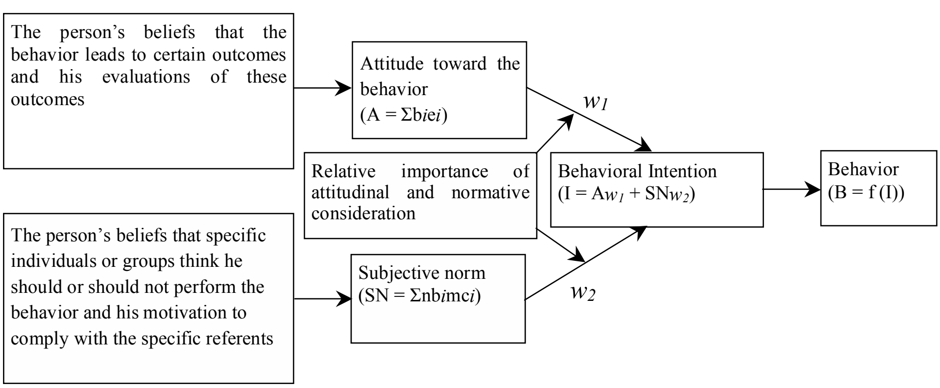
THEORETICAL BACKGROUND: THE THEORY OF REASONED ACTION

The Theory of Reasoned Action assumes that human beings are usually quite rational and make systematic use of information available to them. For this reason, this approach is referred to the "Theory of Reasoned Action (TRA)" (Fishbein & Ajzen, 1975).

According to the TRA, a person's performance of a specified behavior is determined by his behavioral intention (I) to perform the behavior (B = f(I)). Next, the intention is jointly determined by the person's attitude (A) and subjective norm (SN) concerning the behavior in question with relative weights typically estimated by the regression coefficients ($BI = Aw_1 + SNw_2$). Furthermore, a person's attitude toward a behavior is determined by his salient beliefs (b*i*) about the consequences of performing the behavior multiplied by the evaluation (e*i*) of those consequences (A = Σb*i*e*i*). Finally, an individual's subjective norm (SN) is determined by a multiplicative function of his normative beliefs (nb*i*) and motivation to comply (mc*i*) (SN = Σnb*i*mc*i*).

The TRA is a widely accepted model in social psychology to explain virtually any human behavior (Fishbein & Ajzen, 1980). A particularly helpful aspect of the TRA is that it assumes all other factors influence behavior only indirectly by influencing attitude, subjective norms or their relative weights (Davis et al., 1989). Based on this explanatory power, the TRA can be a useful model for explaining knowledge sharing behavior in organizations. Davis et al. (1989) presented the technology acceptance model (TAM) by adapting the TRA to explain the

Figure 1: The Theory of Reasoned Action



Adapted from Figure 1.1 in Understanding Attitudes and Predicting Social Behavior *(Ajzen & Fishbein, 1980, p. 8)* individual's computer usage behavior. In this study, we focus only on the salient beliefs which affect the knowledge sharing attitude, because we assume that the knowledge sharing behavior is motivated and executed mainly at the individual level. The role of social factors may also need to be studied in the future.

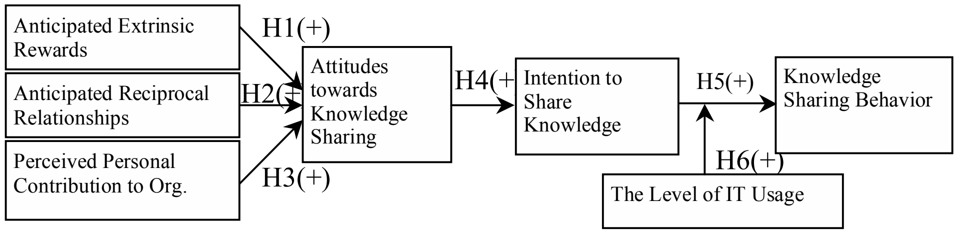
RESEARCH MODEL AND HYPOTHESES

With the advent of the knowledge management paradigm, researchers have examined many variables believed to affect the individual's knowledge sharing behavior. However, there is little research which has investigated the individual's generic motivation to share knowledge in the general organizational context from the social psychological perspective, although there has been the research which dealt with sharing specific knowledge under specific organizational circumstances or focused on knowledge sharing through information systems and knowledge sharing technology itself.

Some studies emphasized knowledge sharing or technology transfer in multi-unit companies, intra-organizations or dispersed teams (Tsai, 2002, 2001; Hansen 2002; Leonard-Barton & Sinha, 1993) in the same company. Another study has been done on knowledge transfer or diffusion method or process (Swap, 2001; Storck & Hill, 2000; Argote, Ingram, Levine & Moreland, 2000; Szulanski 2000; Argote & Ingram, 2000) and other studies investigated the relationship between knowledge transfer and organizational performance (Lapré & Van Wassenhove, 2001; Rulke & Galaskiewicz, 2000; Levin, 2000; Zander & Kogut, 1995). Knowledge or technology transfer in inter-organizational environments, including joint ventures or strategic alliances (Agrawal & Henderson, 2002; Bhagat, Kedia, Harveston & Triandis, 2002; Rynes, Bartunek & Daft, 2001; Lane, Salk & Lyles, 2002; Simonin, 1999; Katz, Rebentisch & Allen, 1996; Coursey & Bozeman, 1992; Smilor & Gibson, 1991) has been another major area to study. Some researchers focused on transferring best practices (O'Dell & Grayson, 1998; Szulanski, 1995), on knowledge representations and knowledge transfer (Boland, Singh, Salipante & Aram, 2001), or on the role of shared or mutual knowledge in a specific group or team (Postrel, 2002; Cramton, 2001; Maas, 2000; Darr & Kurtzberg, 2000; Hoopes & Postrel, 1999; Nelson & Cooprider, 1996). Finally, information or knowledge sharing by using an electronic media (Jarvepaa & Staples, 2000; Dennis, 1996; Niwa, 1990) has been investigated.

Knowledge sharing cannot be done by just implementing information systems. Furthermore, knowledge is a resource locked in human minds. Therefore, investigating the individual's motivation behind knowledge sharing behavior in general organizational context with a solid social psychological foundation should precede

Figure 2: Research Model



as a basis of promoting its members' knowledge sharing in a specific context or specific technology. To achieve this purpose, we propose three factors — anticipated extrinsic rewards, anticipated reciprocal relationships and perceived personal contribution to the organization — identified in social psychology theories as the salient beliefs for knowledge sharing attitude. Based on the TRA, the suggested research model for this study is presented in Figure 2.

Economic Exchange Theory

Knowledge sharing is a form of social interaction among people. Two principal theories which explain the social interaction of people are the economic exchange theory and the social exchange theory. In the findings of the economic exchange theory, individuals will behave according to rational self-interest. Thus, knowledge sharing will occur when its rewards exceed its costs (Kelley & Thibaut, 1978; Constant et al., 1994). Consequently, many researchers have emphasized incentive systems for successful knowledge management. Hence, *anticipated extrinsic rewards* imply that, if employees believe they will receive extrinsic benefits such as monetary rewards, promotion or educational opportunity from their knowledge sharing, they will develop a more positive attitude toward knowledge sharing.

H1: Anticipated extrinsic rewards will have a positive effect on the individual's attitude toward knowledge sharing.

Social Exchange Theory

While the economic exchange theory concerns extrinsic benefits, the social exchange theory concerns intrinsic rewards (Blau, 1967). Social exchange differs from economic exchange in that social exchange entails unspecified obligations. In contrast to economic commodities, the benefits involved in social exchange do not have an exact price in terms of a single quantitative medium of exchange, and the nature of the return cannot be bargained with. This is why only social exchange tends to engender feelings of personal obligation, gratitude and trust.

For example, the initial offer of knowledge to a newcomer in an organization entails a friendly relationship, and the individual who has received the help feels an obligation to reciprocate. If the newcomers reciprocate appropriately, they will prove themselves trustworthy and exchange relations will be established (Gouldner, 1960; Blau, 1967). Thus, intrinsic benefits from social association should be considered as another key determinant of knowledge sharing.

Anticipated reciprocal relationships assume that if employees believe they can improve relationships with other employees by offering their knowledge, they will develop a more positive attitude toward knowledge sharing.

H2: Anticipated reciprocal relationships will have a positive effect on the individual's attitude toward knowledge sharing.

Social Cognitive Theory

A person's attitude and behavior are influenced by self-produced factors as well as by the external agent's stimuli. Among the types of knowledge that employees can derive from self-reflection, none is more central than the employees' judgment of their capabilities to deal effectively with different environmental realities (Stajkovic & Luthans, 1998). Bandura (1975) called this capability "self-efficacy." Self-efficacy is defined as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, p. 391).

Based on the self-efficacy percept, we propose that the individual's judgment of his capabilities to contribute to the organizational performance is going to be a major factor affecting knowledge sharing. This comes from a purely self-motivational source. *Perceived personal contribution to the organization* refers to the idea that if employees believe they can make contributions to the organization's performance, they will develop a more positive attitude toward knowledge sharing.

H3: Perceived personal contribution to the organization will have a positive effect on the attitude toward knowledge sharing.

Theory of Reasoned Action

Hypotheses 4 and 5 examine the relationship between attitude and intention, and the relationship between intention and behavior in the knowledge sharing context. These relationships have been supported by the TRA in other behavioral contexts.

H4: Attitude toward knowledge sharing will have a positive effect on the individual's intention to share knowledge.

H5: Intention to share knowledge will have a positive effect on the individual's knowledge sharing behavior.

The last hypothesis refers to the individual's usage of information technology. Fishbein and Ajzen (1980) argued that several external variables could have an affect when an intention was realized to perform a behavior. Since information technology is considered as an important enabler in knowledge management (Davenport, 1997; Ruggles, 1998; O'Dell & Grayson, 1998), we examine how the individual's level of IT usage affects the knowledge sharing behavior.

H6: The level of information technology usage of the individual will have an interaction effect on the relationship between knowledge sharing intention and knowledge sharing behavior.

RESEARCH METHODOLOGY

To test the proposed hypotheses, we developed measurements for each variable and performed a pretest. Then, the main survey was conducted.

Measurement Development

Items for all independent variables — anticipated extrinsic rewards, anticipated reciprocal relationships and perceived personal contribution to the organization—were newly developed based on the relevant theories and prior studies. Items to measure attitude toward knowledge sharing and behavioral intention were modified from Fishbein and Ajzen's (1980) previous works to make them relevant to the knowledge sharing context. Items for knowledge sharing behaviors and the level of IT usage were adapted from the previous MIS studies.

Before conducting the main survey, we performed a pretest. We tested the internal consistency and discriminant validity of the measurement instrument with 61 responses from 13 organizations in seven industries. The Cronbach's ± value ranged from .71 (for expected rewards) to .95 (for expected contribution). Two out of the 36 items were dropped from the anticipated extrinsic rewards and attitude toward knowledge sharing, respectively, due to the low level of internal consistency.

Data Collection for the Main Survey

The sample consisted of 467 employees in 75 departments of four large

Table 1: Definitions of the Constructs

Constructs	Definitions	Items
Anticipated extrinsic rewards	The degree to which one believes that one can have extrinsic incentives due to one's knowledge sharing	4
Anticipated reciprocal relationships	The degree to which one believes one can improve mutual relationship through one's knowledge sharing	5
Perceived personal contribution to org.	The degree to which one believes that one can improve the organization's performance through one's knowledge sharing	5
Attitude toward knowledge sharing	The degree of one's positive feelings about sharing one's knowledge	6
Behavioral intention to share knowledge	The degree to which one believes that one will engage in a knowledge sharing act	5
Knowledge sharing behavior	The degree to which one actually shares one's knowledge	7
Level of IT usage	The degree of one's frequency of using IT such as BBS and email	4

government-invested organizations in Korea. A brief description on each organization is shown in Table 2.

The data was gathered by means of a questionnaire in October and November of 1999. Overall, of the 900 questionnaires that were distributed, 861 questionnaires were received and 467 were usable. Detailed descriptive statistics of the respondents' characteristics are shown in Table 3. The unit of analysis for this study is the individual.

Measurement Assessment

Content Validity

Content validity refers to the representativeness and comprehensiveness of the items used to create a scale. It is assessed by examining the process by which scale items are generated (Straub, 1989). In this research, definitions of anticipated extrinsic rewards, anticipated reciprocal relationships and perceived personal contribution to the organization were initially proposed based on reviews of the

Table 2: Company Profiles

Company	Business Domain	Established	% of govn't share*	# of employees*	Revenue*
A	Produce & distribute natural gas	1983	50.2%	2,396	$3.6 mil.
B	Provide district heating	1985	46.1%	792	$2.8 mil.
C	Operate the subway	1994	N/A	518	N/A
D	Process & distribute the farm products: provide banking service	1961	Owned by the farmer	1,620	Nonprofit org.

** Year 1999*

Table 3: Profile of Respondents

Measure	Items	Frequency	%	Measure	Items	Frequency	%
Gender	Male	413	92.6	Gender	Female	33	7.4
Age	21~29	109	25.7	Work	0~3	76	17.5
	30~34	182	42.9	Experience	3~6	203	46.6
	35~39	73	17.2	(year)	6~9	54	12.5
	Over 40	60	14.2		9~	102	23.4
Position	Employee	97	21.7	Work	1~2	106	28.0
	Senior employee	222	49.8	Training	3~4	138	36.4
	Manager	95	21.3	(# of times)	5~6	78	20.6
	Director	32	7.2		Over 7	57	15.0
Education	High school	37	6.5	Work	1~10	88	25.4
	College(2yrs.)	50	8.7	Training	11~20	125	36.0
	Univ.(4yrs.)	326	56.9	(# of days)	21~30	63	18.1
	Graduate	24	4.2		31~	71	20.5
	Etc.	7	1.2%				

economic and social exchange theories and self-efficacy theory. Previous research in IS and other disciplines was comprehensively reviewed to develop the measurement items. Definitions of attitude, intention and behavior are based on Fishbein and Ajzen's TRA, which has been widely accepted in social psychology.

Construct Validity

Construct validity looks at the extent to which a scale measures a theoretical variable of interest. There are, however, many different aspects of construct validity that have been proposed in the psychometric literature (Bagozzi et al., 1991). In this study, we followed Straub's (1989) process of validating instruments in MIS research to test construct validity in terms of convergent and discriminant validity.

To test construct validity, item analysis and factor analysis with varimax rotation were performed. For convergent validity, we evaluated the item-to-total correlation, that is the correlation of each item to the sum of the remaining items. Discriminant validity was checked by using the factor loading values. Three items (one item in attitude toward knowledge sharing, one item in knowledge sharing behavior and one item in level of IT usage) with item-to-total correlation lower than

Table 4: The Results of Measurement Assessment

Measure	Item	Mean	S.D.	Cronbach α
Anticipated Extrinsic Rewards	3	2.255	0.878	.8276
Anticipated Reciprocal Relationships	5	3.573	0.781	.9335
Perceived Personal Contribution to the Organization	5	3.510	0.736	.8924
Attitude to Knowledge Sharing	4	3.934	0.705	.8737
Intention to Share Knowledge	5	3.846	0.633	.8886
Knowledge Sharing Behavior	6	2.894	0.661	.8214
Level of IT Usage	3	3.158	0.895	.7609

Table 5: Rotated Component Matrix

Items	Component						
	1	2	3	4	5	6	7
AER 1	.828						
AER 2	.900						
AER 3	.799						
ARR 1		.820					
ARR 2		.844					
ARR 3		.825					
ARR 4		.800					
ARR 5		.745					
PPCO 1			.589				
PPCO 2			.743				
PPCO 3			.824				
PPCO 4			.802				
PPCO 5			.783				
Attitude 1				.666			
Attitude 2				.763			
Attitude 3				.829			
Attitude 4				.779			
Intention 1					.734		
Intention 2					.778		
Intention 3					.826		
Intention 4					.811		
Intention 5					.775		
Behavior 1						.719	
Behavior 2						.693	
Behavior 3						.698	
Behavior 4						.797	
Behavior 5						.712	
Behavior 6						.653	
Level of IT Usage 1							.809
Level of IT Usage 2							.851
Level of IT Usage 3							.786
Eigenvalues	1.499	9.054	2.498	1.700	3.607	2.069	1.283
% of variance explained	4.835	29.208	8.059	5.485	11.637	6.674	4.140
Cumulative %	65.898	29.208	48.904	61.063	40.845	55.579	70.038

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization
A rotation converged in 6 iterations
AER: Anticipated extrinsic rewards; ARR: Anticipated reciprocal relationships; PPCO: Perceived personal contribution to the organization; Attitude: Attitude toward knowledge sharing; Intention: Intention to share knowledge; Behavior: Knowledge sharing behavior

0.5 were dropped. No items were dropped due to factor analysis. Internal consistency for all constructs was investigated using the Cronbach's alpha values. The results of measurement assessment are shown in Table 4 and 5.

RESULTS OF HYPOTHESIS TESTING

In this study, we aimed to find the salient beliefs affecting an individual's knowledge sharing attitude, and to apply Fishbein and Ajzen's model in the

Table 6: Hypothesis Test Results

Equation	R²	ΔR²	β	Hypothesis test results
Attitude toward knowledge sharing (A) A=AER+ARR+PPCO+errors AER ARR PPCO	.304***		 -.124** .382*** .237***	 H1: not supported H2: supported H3: supported
Intention to share knowledge (I) I=A+errors	.323***		.568***	H4: supported
Knowledge Sharing Behavior (B) B=I+errors	.014*		.118*	H5: supported
Knowledge Sharing Behavior B=I+IT+I×IT+errors I IT I×T	.054	.000	 .094 .168 .039	H6: not supported

****p<0.001, **p<0.01, *p<0.05, †p<0.1*
AER: Anticipated extrinsic rewards, ARR: Anticipated reciprocal relationships, PPCO: Perceived personal contribution to the organization, IT: The level of IT usage

knowledge sharing context to understand how these factors affect knowledge sharing behavior. In addition, we tried to explicate the role of IT as an enabler of knowledge sharing behavior. The hypothesized relationships depicted in Figure 2 were tested using regression analysis. Table 6 presents a summary of the hypothesis tests.

Hypotheses 1 to 3 examine the links between the employee's beliefs about anticipated extrinsic rewards, anticipated reciprocal relationships and perceived personal contribution to the organization, and the attitude toward knowledge sharing. While anticipated reciprocal relationships (*beta* = .382, *t*-value = 7.542, $p < .001$) and perceived personal contribution to the organization (*beta* = .237, *t*-value = 4.706, $p < .001$) are positively related to the attitude as expected, anticipated extrinsic rewards (*beta* = -.124, *t*-value = -3.127, $p < .01$) are negatively related to the attitude. Therefore, Hypothesis 1 was not supported, and Hypotheses 2 and 3 were supported.

Hypotheses 4 and 5 examine Fishbein and Ajzen's model in the knowledge sharing context. Attitude toward knowledge sharing (*beta* = .568, *t*-value = 14.995, $p < .001$) has a significant influence on behavioral intention. Thirty-two percent of the variance of behavioral intention to share knowledge is explained by the attitude toward knowledge sharing. Also, an individual's actual knowledge sharing behavior is highly correlated with the behavioral intention to share knowledge. The positive influences of attitude on intention and intention on behavior are confirmed in the knowledge sharing context, too.

For the last hypothesis, we investigated the moderating effect of an individual's level of IT usage on knowledge sharing behavior. The individual's level of IT usage does not show a significant moderating effect on the knowledge sharing behavior (R^2 Change = .000, F-value Change = .016, p = .900). Thus, Hypothesis 6 is not supported.

DISCUSSION OF RESULTS

One of the most interesting findings of this study is the anticipated extrinsic rewards variable. Many researchers as well as practitioners have emphasized the importance of rewards in knowledge sharing. From a theoretical perspective, the economic exchange theory also suggests that a person behaves after calculating the expected rewards and costs incurred by his or her behavior. However, contrary to many researchers' expectations, this research shows that the attitude toward knowledge sharing is negatively related to the anticipated extrinsic rewards. That is, the anticipated extrinsic rewards tend to discourage the formation of a positive attitude toward knowledge sharing.

We may find a reasonable explanation for this negative relationship in the pay-performance research. Even though the assumption that people will do a better job if they are promised some sort of rewards is still pervasive, a number of studies on pay-performance have shown that there is no relationship, or even a negative relationship between rewards and performance (Kohn, 1993). Kohn provided six reasons why rewards failed, many of which are applicable in the knowledge sharing context, too.

First of all, he insists that rewards have a punitive effect because they are manipulative comparable to outright punishment. Further, not receiving a reward that one has expected to receive is indistinguishable from being punished. Secondly, rewards break off relations. For each person who wins, there are many others who feel they have lost. When employees compete for a limited number of incentives, they will very likely begin to see each other as competitors to their own success. Next, managers often use incentive systems as a substitute for giving workers what they need to do a good job — providing useful feedback, social support and the room for self-determination. Finally, rewards, like punishment, may actually undermine intrinsic motivation. The more they experience being controlled, the more they tend to lose interest in what they are doing. Furthermore, the recipient of the reward assumes, "If they have to bribe me to do it, it must be something I wouldn't want to do." So, the larger the incentive they are offered, the more negatively they view the activity for which the bonus is received.

The next explanation is related to the organizational citizenship behavior (OCB) literature. *OCB* can be defined as "willingness of persons to contribute efforts to the cooperative system" by Barnard (1938, p. 83). Almost 30 years later, Barnard, Kats and Kahn (1966, 1978) suggested that reward systems might inhibit cooperation (Organ & Konovsky, 1989), because critical voluntary behaviors that are not specified by job descriptions are largely a function of identification and internalization rather than instrumental involvement (O'Reilly & Chatman, 1986). According to Constant et al. (1994), experienced workers learned that they should share their knowledge which was acquired from their work and training. Therefore, they may have a negative attitude toward receiving extrinsic benefits in return for knowledge sharing behavior which they perceive as a normal business activity.

Do rewards play no role for knowledge sharing? Why do many researchers and practitioners emphasize the role of rewards in knowledge sharing? To answer these questions, let us borrow Triandis' (1980) model. Triandis proposed a theory that incorporated many of the same concepts and constructs of Fishbein and Ajzen, but also modified and redefined them (Thompson et al., 1991). He acknowledged that even when intentions were high, behavior might not occur if certain conditions of a particular situation, for example accessibility, made the behavior impossible.

We expected that rewards could be a facilitating condition for knowledge sharing similar to accessibility. Many practitioners mentioned that rewards played an important role in the initiation stage of knowledge management. From the theoretical point of view, Kelman (1958) argues that rewards succeed at securing only one thing: temporary compliance. Once the rewards run out, people revert to their old behavior (Kohn, 1993). In technical terms, the marginal utility of increasing amounts of extrinsic benefits eventually diminishes (Blau, 1967). This means that rewards may be a trigger for knowledge sharing, but they are not a fundamental force for forming a person's attitude.

We also suggested that the level of IT usage of an individual would have a moderating effect on the knowledge sharing behavior, because IT was described as an enabler for knowledge sharing in much of the available literature (Davenport, 1997). We expected people who had intentions to share their knowledge and used IT frequently would actually share their knowledge more frequently through BBS, e-mail, etc. However, the moderating effect of the individual's level of IT usage was not significant. It may be necessary to measure the construct of IT usage with more diverse types of IS for knowledge sharing, because sharing of explicit knowledge is done mostly through intranets and formal knowledge repositories in many organizations.

IMPLICATIONS AND FUTURE RESEARCH

The result of this study suggests that the reward system for knowledge management may need to be reexamined. Incentives (referred to as "extrinsic motivators") do not seem to alter the attitude that underlies our knowledge sharing behavior. They do not create an enduring commitment to any action. Rather, incentives merely—and temporarily—change what we do (Kohn, 1993). It is no more than a trigger or facilitating condition. When it comes to producing lasting changes in attitude, however, rewards, like punishment, are strikingly ineffective (Kohn, 1993). The role of an individual's level of IT usage falls to the same conclusion.

However, since social benefits have no exact price, the marginal utility function does not apply to the anticipated reciprocal relationships and perceived personal contribution to the organization. Therefore, the frequent rendering of OCB like knowledge sharing seems to mainly foster a sense of social exchange relationship. Employees who think knowledge sharing will increase the scope and depth of associations among organizational members tend to have a positive attitude toward knowledge sharing. Their positive attitudes toward knowledge sharing are formed by the expectations of reciprocation on knowledge sharing. Moreover, employees who believe in their ability to contribute to improvements of organizational performance have a positive attitude toward knowledge sharing. Therefore, we should pay more attention to enhancing the positive mood state for social associations which precedes knowledge sharing behaviors and should provide useful feedback to improve the individual's self-efficacy instead of designing an elaborate evaluation and incentive system.

Even though this research has drawn intellectually and practically meaningful implications, there are a few limitations. First of all, the use of self-report scales to measure the study variables involves the possibility of the common method bias for some of the results obtained. In order to pursue further investigation of the conceptual model, it will be appropriate to develop more direct and objective measures for knowledge sharing behavior.

Secondly, data of this study was collected from the firms in the public sector of Korea. The results might not be generalizable due to the organizational characteristics unique to the government-invested organizations of Korea. In order to generalize the results from this study, we need to collect data from various industries and countries.

Finally, because we considered knowledge sharing as a very individualistic behavior, we focused only on the salient beliefs that affected the attitude toward knowledge sharing. However, according to Fishbein and Ajzen, behavioral intention is determined by social factors as well as by the attitude. Therefore, social factors need to be considered in future research to increase the explanatory power of the research model.

For further research, it will be interesting to compare Fishbein and Ajzen's model with Triandis' model. In terms of the facilitating conditions, the explanatory power of Triandis' model seems to be stronger than Fishbein and Ajzen's model. However, Fishbein and Ajzen's model is simpler and more widely accepted. To provide a more accurate explanation on knowledge sharing behavior based on Fishbein and Azjen's model, a longitudinal approach also needs to be taken.

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Chapter XII

Intentions to Use Groupware: The Influence of Users' Perceptions

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ABSTRACT

Information technologies that support groups of individuals have become increasingly visible. While some of these, such as electronic mail, have become almost ubiquitous in many organizations, other groupware applications have not enjoyed similar acceptance. This study uses diffusion of innovation theory to investigate factors that may influence intentions to use a specific groupware application, Lotus Domino discussion databases. Findings indicate that intentions to use Domino discussion databases are impacted by perceptions of relative advantage, complexity, compatibility and result demonstrability. There was not a significant relationship between intentions to use and perceived trialability, visibility or voluntariness. Suggestions for positively

impacting important perceptions are also offered. Those interested in increasing the use of groupware technologies may find these suggestions helpful in guiding their efforts.

INTRODUCTION

Although a number of groupware applications such as e-mail have become an almost ubiquitous part of many organizations, other groupware applications have not been as universally adopted (Orlikowski, 1993). This phenomenon is not only exhibited in business organizations, but also extends to educational institutions. Anecdotal evidence indicates that many professors and students now interact via e-mail on a regular basis, while groupware systems have not been as widely adopted (Orlikowski, 1993). Research aimed at increasing our understanding of the diffusion and adoption of various groupware technologies represents an important direction for groupware research (Nunamaker, 1997).

The research reported in this chapter represents an attempt to use a diffusion of innovation perspective (Rogers, 1995) to understand factors that may impact intentions to use a groupware technology in an educational environment. Specifically, this chapter investigates the following research question:

> *Are adopters' perceptions of the characteristics of groupware technology related to their intentions to use the technology?*

The answer to this question holds implications for practitioners as well as researchers. Research has been called for to investigate the applicability of diffusion of innovation theories to interactive communication technologies such as groupware (Rogers, 1991). Practitioners who wish to use groupware in an educational setting might use the findings of this research to increase participants' use of groupware technologies.

DOMINO GROUP SUPPORT SYSTEM

Groupware is technology designed to facilitate the work of groups. This technology may be used to communicate, cooperate, coordinate, solve problems, compete or negotiate. While traditional technologies such as the telephone qualify as groupware, the term is ordinarily used to refer to a specific class of technologies relying on modern computer networks, such as e-mail, newsgroups, videophones or chat.

Figure 1: Groupware Classification

	Same time “synchronous”	**Different time** “asynchronous”
Same place “co-located”	Group decision support systems, voting, presentation support	Shared computers
Different place “distance”	Videophones, chat	Discussions, e-mail, workflow

Groupware technologies are typically categorized along two primary dimensions, time and place (Johansen, 1988), as shown in Figure 1. Based on the time dimension of Figure 1, users of the groupware can work together at the same time or different times. On the other hand, the place dimension indicates that groupware users can work together in the same place or in different places.

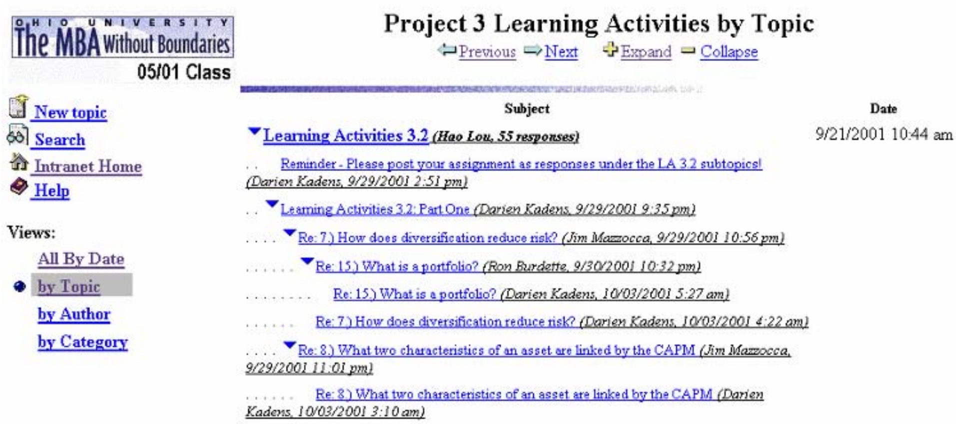
One promising application of groupware technologies is the support of teams, particularly virtual teams. Virtual teams use technology to cross geographic, temporal and organizational boundaries. The increasingly complex, global nature of work tasks has led to an increasing interest in virtual teams (Bell & Kozlowski, 2002). One of the factors thought to contribute to the popularity of virtual teams is the availability of groupware systems that help virtual teams collaborate (Townsend, DeMarie & Hendrickson, 1998). The sophisticated communication facilities of groupware facilitate frequent communication among team members. Frequent communication has been cited as an important factor in creating a sense of team identity in virtual teams (Kezsbom, 2000). In particular, asynchronous groupware helps overcome time-related barriers to distributed work (Kelly & Jones, 2001).

In this study, the groupware investigated was the Lotus Domino discussion database, an asynchronous groupware product designed to be used by users “any time and any place.” Since there is also no requirement for users to be co-located, the technology falls into the lower right-hand portion of the grid in Figure 1.

The Domino discussion database is one of the Lotus Notes groupware applications made available to Web browsers via the Domino HTTP server technology. One may think of a Domino discussion database as an informal meeting place, where the members of a workgroup can share ideas and comments. Like a physical meeting, each member of the workgroup “listens” to what others have to say, and can voice his or her own opinion. However, unlike a physical meeting, the participants do not have to be in the same place at the same time to share information. People can participate when it is convenient for them to do so.

Users can access Domino discussion databases and participate in group discussions directly from the Internet using a Web browser. One advantage of Domino is that users no longer need special Notes client software in order to participate in group discussions. If they have access to the Web and a Web

Figure 2: Discussion Thread in a Domino Discussion Database



browser, they can access the discussion database. This feature is particularly important given the global reach of the Internet, which makes it possible for globally distributed teams to interact (Davison & de Vreede, 2001).

Users have the ability to simply browse through discussion topics and responses contributed by others. This is particularly useful for new workgroup members who need to become oriented to important issues regarding the group. The history of any discussion is preserved in the discussion database, and is presented as a discussion thread. Figure 2 illustrates a threaded discussion.

In a threaded discussion, browser users can either respond to an existing discussion thread or create a new discussion thread by posting a new topic in a Domino discussion database. Posted items can also be edited and deleted by the author just as with the standard Notes client.

Domino discussions support the important notion of parallelism. Parallelism is the ability for members of a group to submit items simultaneously; one user does not have to wait for another to finish before submitting an item to a discussion. This capability is considered to be an important advantage of electronic communication when compared to verbal communication. Production blocking (waiting to speak) can cause poor performance when groups interact verbally (Fjermestad & Hiltz, 2000-2001).

RESEARCH MODEL

Diffusion of innovation theory serves as the theoretical basis for this study. Diffusion of innovation theory is concerned with how the use of an innovation spreads throughout a social system (Mahajan, Mueller & Bass, 1990). Diffusion theory has been applied to a wide range of technologies, including information and communication technologies such as groupware.

The Technology Acceptance Model (Davis, 1989) is an alternative, but related, perspective on the acceptance and adoption of technology. While the Technology Acceptance Model (TAM) has added to the field's knowledge of the factors that lead individuals to use information systems, components of the model are conceptually similar to constructs considered in diffusion theory (Moore & Benbasat, 1991). Diffusion theory also includes a number of additional factors that are thought to influence adoption and use intentions. Because of this additional richness and its wide acceptance, diffusion of innovation theory is used as the theoretical basis for this investigation.

An often studied area related to innovation adoption is the impact of adopter perceptions of the characteristics of an innovation on its adoption (Gatignon &

Table 1: Perceived Innovation Characteristics

Characteristic	Definition	Conceptual References	Empirical References
Relative advantage	Degree to which an innovation is seen as being superior to its predecessor	Rogers, 1995; Tornatzky & Klein, 1982; Kwon & Zmud, 1987	Teo, Tan & Wei, 1995; Prekumar et al., 1994
Complexity	Degree to which an innovation is seen by the potential adopter as being relatively difficult to use and understand	Rogers, 1995; Tornatzky & Klein, 1982	Cooper & Zmud 1990; Grover 1993; Teo et al., 1995
Compatibility	Degree to which an innovation is seen to be compatible with existing values, beliefs, experiences and needs of adopters	Rogers, 1995; Lancaster & Taylor, 1986; Gatignon & Robertson, 1985	Nedovic-Budic & Godschalk, 1996; Taylor & Todd, 1995; Grover, 1993; Eastlick, 1993
Trialability	Based on adopters' perceptions of the degree to which an innovation can be used on a trial basis before confirmation of the adoption must occur	Rogers, 1995; Lancaster & Taylor, 1986	Teo et al., 1995
Result demonstrability	Degree to which the results of using an innovation are perceived to be tangible	Moore & Benbasat, 1991	Herbert & Benbasat, 1994
Visibility	The perception of the actual visibility of the innovation itself as opposed to the visibility of outputs	Moore & Benbasat, 1991	Agarwal & Prasad, 1997
Voluntariness	Degree to which use of an innovation is perceived as being of free will	Moore & Benbasat, 1991	Agarwal & Prasad, 1997

Robertson, 1985; Lancaster & Taylor, 1986; Rogers, 1995). It is important to note that it is the potential adopters' *perceptions* of these characteristics rather than an expert's objective assessment of how an innovation rates on these characteristics that impacts the diffusion rate (Lancaster & Taylor, 1986; Rogers, 1995).

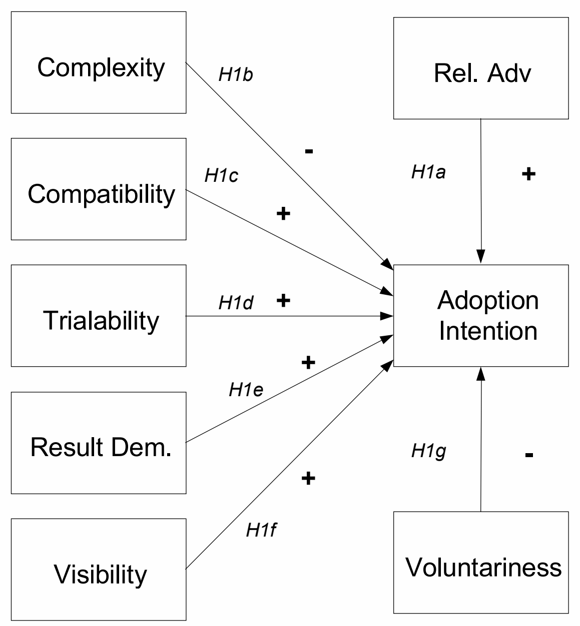
Rogers (1995) lists five perceived characteristics of an innovation that can help to explain its adoption or rejection: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability. Others have proposed characteristics that may influence adoption, including perceived usefulness and perceived ease of use (Davis, 1989), which are conceptually similar to relative advantage and complexity (Moore & Benbasat, 1991). Other constructs of interest to this study include voluntariness, result demonstrability and visibility. Table 1 gives definitions for the characteristics included in this study. In addition, the table provides references for both conceptual and empirical studies related to each construct. Interested readers may wish to consult these articles for additional information on these perceived innovation characteristics.

Many other characteristics of innovations have been studied. However many of these are specific to the innovation being investigated or have not been widely studied. For purposes of this study, seven constructs seem to be the most appropriate to include: (1) relative advantage, (2) complexity, (3) compatibility, (4) result demonstrability, (5) visibility, (6) trialability, and (7) voluntariness. Relative advantage, complexity, compatibility and trialability are included because they have been often included in studies of IT innovations. In addition, the inverse of complexity, ease of use, has been cited as important in the acceptance of groupware (Kline, 2001). Moore and Benbasat (1991) provide empirical support for their notion of breaking observability into two constructs: result demonstrability and visibility. As a result, this study includes these two constructs. Finally, the use of Domino discussion database was not required of every student subject in this study. Therefore, it is appropriate to include a measure of subjects' perceptions of the degree to which use was mandated, so perceived voluntariness is included in the research model.

Intention to Use

Intention to use Domino discussion databases is the dependent variable in the research model. Although intentions to use and actual use are not the same concepts, they are related. A number of studies have investigated use or adoption intentions, including Davis (1989), Taylor and Todd (1995), and Chin and Gopal (1995). Further, there is empirical support for a correspondence between intentions and subsequent actual behavior (Davis, 1989).

Figure 3: Research Model



The research model derived from the relationships between intention to use and each of the factors discussed in this section is shown in Figure 3. The expected direction of each relationship is indicated on the corresponding path. Each path shows a hypothesis number that corresponds to a specific hypothesis. These hypotheses are discussed in the following section.

METHODOLOGY

Study Context

This study was conducted in the context of a number of courses using a problem-based, collaborative learning model. The Domino-based system is designed to support student-centered, project-based courses where faculty serve as facilitators of student learning as opposed to providers of information. This model is based on the extensive research in problem-based learning which arises from a constructivist philosophical view of how learning occurs within or is constructed by the learner as opposed to being provided by external sources.

The constructivist view of learning sees instruction as being learner centered. In this view, better learning occurs when the learner is forced to make discoveries on his or her own, rather that being fed the information (O'Loughlin, 1992). In the constructivist world, the professor is more of a facilitator or mentor than a "sage on a stage." The instructor's role is to provide tools for helping the learners make discoveries and construct their view of reality. The learners pursue projects, which are designed to allow them to place their focus on finding relationships among concepts while putting the learner in a real-world context (Jonassen, 1994).

The collaborative model of learning builds on constructivism by assuming that additional learning can be achieved when knowledge is shared between students. The instructor's role is to maximize the sharing of knowledge among learners as opposed to controlling the content and delivery of material (Leidner & Jarvenpaa, 1995).

From this basis of collaborative learning, we have designed both single courses and team-taught, integrated, interdisciplinary course clusters, both at the undergraduate and the graduate level, in which students are presented with a series of problems which they must work on in teams. This approach has been used both with traditional, residential students and with non-traditional, remote students.

The problems presented to students are specifically designed around a set of learning outcomes that the students must address in the process of working on the problem. Problems are designed to present students with authentic situations that are similar to decisions facing business professionals today. In the course of working on the problem, students must perform basic research to construct an understanding of the problem domain. This result in the generation of potential recommendations (hypotheses) which the students "test" against one another and the faculty.

Characteristics of the Sample

In order to test the research model, a survey was administered to students in a number of business courses at a major Midwest university. The selection of courses was made based on the availability of the Domino discussion databases. Only students enrolled in a course where Domino was made available to the students as part of the course were included in the study. Completion of the survey was voluntary and could be done outside of class.

A total 186 surveys were completed. The mean age of the sample was 25.9 years old, the mean full-time work experience was 5.5 years and the mean number of years of computer experience was 8.5. Table 2 summarizes these characteristics.

Table 2: Sample Characteristics (Descriptive)

Characteristic	Median	Mean	Std. Dev.
Age	22.5	25.9	7.28
Work experience	3.0	5.5	7.19
Computer experience	8.0	8.5	4.13

Table 3: Sample Characteristics (Frequencies)

Characteristic	Frequency
Gender	
- Female	98
- Male	88
Class	
- Sophomore	4
- Junior	41
- Senior	139
- Graduate	2
Prior e-mail use	172
Prior Web use	172
Prior word processor use	164

Of the 186 responses, 98 were from females and 88 from males. No freshmen responded, while there were responses from four sophomores, 41 juniors, 139 seniors and two graduate students. Only 14 of the respondents reported no prior e-mail use, 14 had never used the Web before and 22 had never used a word processor. Ninety of the respondents reported that they had not used Domino in previous courses. Table 3 summarizes these frequencies exhibited in the sample.

Generalizability of the Sample

When students are used as the sample for a study, there is often concern for the generalizability of the results. When students are asked to perform contrived tasks that are not of direct relevance to them, this concern is often valid. However, when the domain area of the study is of relevance to the student subjects, the negative effects are mitigated (Gopal, Bostrom & Chin, 1992). In this research, students were surveyed about a topic that held direct relevance to them, the use of a technology associated with their course work. Students were not being asked to project themselves into an artificial role; they were asked their perceptions as students. Thus, it is reasonable to expect that any associations found between their perceptions and their adoption intentions are valid. In addition, it is common practice to use student subjects in studies related to perceptions of technologies. Many studies of technology acceptance and usage have employed students as their subjects (Taylor & Todd, 1995; Chin & Gopal, 1995; Davis, 1989).

It should also be noted that many of the subjects in this study have some work experience. The mean full-time work experience for the sample was 5.5 years. Further, 40% of the sample reported having four or more years of full-time work experience. Interestingly, when characteristics of the sample were tested for the significance of their relationship with use intention, work experience was highly non-significant ($p=0.814$). This indicates that the subjects' level of work experience had little impact on their intentions to use Domino, which may lead one to believe that in this context, the use of students rather than organizational employees may have less impact than it might in other settings.

Measures

Most items for the measurement instrument were adapted from an instrument developed and validated by Moore and Benbasat (1991). Items were measured using a seven-point Likert-type scale. Since minor changes were made; the instrument was re-validated. The reliability of each construct scale was assessed by computing Cronbach's (1970) coefficient alpha (α). Scale reliabilities range from 0.77 to 0.96, indicating that they exhibit an acceptable level of reliability ($\alpha > 0.70$) (Nunnally, 1978). Further, the a scores are all in the same range as those reported by Moore and Benbasat (1991).

The scales were further validated by performing a series of factor analyses, with one analysis performed for each scale. Due to limitations imposed by the sample size, a single factor analysis including all measurement items was not performed. Each factor analysis used a maximum likelihood extraction, a promax orthogonal rotation and extracted all factors with Eigen values greater than one. In all cases, the analysis indicated that the scale items associated with a given construct loaded on a single factor. This can be interpreted as meaning that each set of scale items measures a single construct. In addition, with the exception of one item, all items exhibited factor loadings over the commonly used cutoff of 0.40. The only exception was a single item in the complexity scale that had a factor loading of 0.38. To maintain consistency with the original scale and with other studies that have employed the scale, the item was retained.

Intention to use was operationalized as the mean response to four items designed to measure the subjects' perceptions of how likely they felt they would be to use Domino in future courses. Note that students must make a decision to re-adopt Domino each term. Future courses may or may not use the technology. Thus, students in effect are faced with a new adoption decision at the beginning of each term.

A single value was computed for each scale by computing a mean value of each subject's responses corresponding to all items in the scale. Note that a number of items were reverse worded in the instrument. These items were re-coded before the mean was computed.

Hypotheses

A series of testable hypotheses can be developed from the research model and the operationalizations of the constructs of interest. These are shown below.

H1: Student perceptions of the characteristics of Domino discussion database technology are related to their intention to use the technology.

Several sub-hypotheses can be derived from H1, all of which are similar in wording. H1n shows the general form for each hypothesis. Table 4 shows the hypothesis number, scale of interest and hypothesized relationship direction for each sub-hypothesis.

H1n: Student perceptions of the X of Domino discussion database technology as measured by the X scale are positively/negatively related to their intention to use the technology.

DATA ANALYSIS

Regression analysis was chosen as the appropriate method to test the hypotheses related to relationships between intention to use and perceived innovation characteristics. The study uses the individual level of analysis and individual students as the experimental units.

A number of assumptions concerning the error term (ε) underlie the statistical tests used in regression analysis (Mendenhal & Sincich, 1993). As recommended by Mendenhal and Sincich (1993), a number of procedures were performed to see if the data collected meet these assumptions. All assumption checks were performed on a parsimonious main effects model.

Table 4: Hypotheses

Hypothesis	**Characteristic (X)**	**Direction**
H1a	Relative advantage	Positive
H1b	Complexity	Negative
H1c	Compatibility	Positive
H1d	Trialability	Positive
H1e	Result demonstrability	Positive
H1f	Visibility	Positive
H1g	Voluntariness	Negative

Independent error terms: Since the data analyzed here are not time-series, there is little chance that the value of one error term would impact the value of any other. Hence, the error terms can be considered independent.

Normality: The normality assumption was checked by examining a normal probability plot. This plot graphs the expected value of residuals against actual residual values. Since in the case of this data the plot is close to a straight line, the normality assumption is satisfied.

Expected value of ε is zero: To check this assumption, each independent variable referred to in the hypotheses was plotted against the error terms. When there is no discernable pattern to these plots, this assumption can be considered satisfied. There was no discernable pattern to any of these plots, so this assumption is satisfied.

Constant variance: This assumption was checked by plotting the predicted values of the dependent variable of interest (use intention) against the residual values. There is no discernable pattern to this plot, indicating that there is no general trend of more or less variance in the residual as the predicted value of the dependent variable changes. Therefore, it can be concluded that the constant variance assumption is satisfied.

Multicollinearity: In order to check for multicollinearity, variance inflation factors (VIFs) were calculated for each β term in the regression model. When the largest of the VIF exceeds 10, then severe multicollinearity is present. However, for this data, the largest VIF was 3.265, indicating that there is little concern of problems due to multicollinearity.

Outliers: Outliers are commonly defined as residual values that fall more than three standard deviations from the mean. If outliers are present, it is useful to determine their influence on the analysis. However, there were no outliers for this data set.

Hypotheses Testing

Before testing the above hypotheses, a regression model was created that included the perceived innovation characteristic measures, and all measured covariates as independent variables and use intention as the dependent variable. This was done to determine if any of the covariates should be included in the regression equation used to test the specific hypotheses. Table 5 shows the results of the hypothesis tests of individual parameters associated with the potential covariates. No term corresponding to a covariate was significant ($\alpha = 0.05$). As a result, none of the covariates were included in the final model.

Table 5: Covariate Significance Levels

Variable	Significance
Work experience	0.814
Computer experience	0.793
Age	0.106
On campus course	0.132
Gender	0.519
Previous email use	0.672
Previous Word processor use	0.637
Previous Web used	0.912
Previous Domino use	0.650

The regression equation used as the basis for the tests corresponds to a parsimonious main effects model. When the sample data are fit to the model using ordinary least squares regression, the following regression equation results.

$$AI = 0.375 + 0.383RA + 0.335CP - 0.170CX + 0.012TR + 0.207RD - 0.027VI + 0.044VO$$

In order to evaluate H1, which states that perceptions of the characteristics of the Domino will be related to intent to use, an F test was used to determine whether at least one of the terms in the model was significant. The F statistic value of 36.313 (degrees of freedom = 7/178) is significant at an $\alpha < .001$. This indicates that the null hypothesis of no term in the regression model being significant can be rejected — there is some association between the perceived innovation characteristic measures and measures of use intention. In other words, H1 is supported. The adjusted R^2 value for the model is 0.656, indicating that model can account for 65.6% of the sample variation in intention to use.

The next step in the analysis is to test the significance of the individual terms in the model. These tests correspond to H1a-H1g. The null hypotheses tested, the t

Table 6: Hypotheses Tests Results

Construct	Hypothesis	Significance	Support
Relative advantage (RA)	H1a	< 0.001	Supported
Complexity (CX)	H1b	0.035	Supported
Compatibility (CP)	H1c	< 0.001	Supported
Trialability (TR)	H1d	0.824	Not supported
Result demonstrability (RD)	H1e	0.014	Supported
Visibility (VI)	H1f	0.601	Not supported
Voluntariness (VO)	H1g	0.475	Not supported

statistic and significance level are shown in Table 6, as is whether the hypothesis is supported ($\alpha < 0.05$).

As can be seen from Table 6, the hypotheses related to relative advantage (H1a), complexity (H1b), compatibility (H1c) and result demonstrability (H1e) are supported, while those related to trialability (H1d), visibility (H1f) and voluntariness (H1g) are not supported.

CONCLUSIONS AND MANAGERIAL RECOMMENDATIONS

From the data gathered in this study, it can be concluded that there is a relationship between student perceptions of the characteristics of Domino discussion databases and their intention to use the technology. More specifically, their perceptions of the relative advantage, complexity, compatibility and result demonstrability of Domino have significant relationships with their adoption intentions. In general, the results of this study are consistent with prior research. Relative advantage, complexity (ease of use) and compatibility have received the most consistent support as factors that influence adoption and use of an innovation (Herbert & Benbasat, 1994). The additional significant perceived innovation characteristic, result demonstrability, has not been as widely studied as some of the other factors. However, its relationship to use intention has been supported empirically (Agarwal & Prasad, 1997; Herbert & Benbasat, 1994). These results are discussed in more detail below.

Rogers (1991) called for research into the applicability of diffusion of innovation theory to interactive communication technologies. This research demonstrates that diffusion theory can be used to help explain intentions to adopt a specific interactive communication technology—groupware. Further research is required to investigate whether diffusion theories hold for other interactive communication technologies.

One interesting finding of this research comes from the examination of the relative strengths of the associations between the individual independent variables and adoption intention. The results clearly indicate that perceived relative advantage and compatibility can explain more of the variation in adoption intention than can result demonstrability and complexity. Stated differently, for these subjects, perceptions of the relative advantage and compatibility of Domino are better predictors than are perceptions of result demonstrability and complexity.

Examination of subjects' comments regarding Domino help shed light on these findings. It was common for subjects to comment on a number of advantages of using Domino. For example, a number of subjects mentioned the value of the frequent and timely feedback from the instructor afforded via Domino. Also, there were many comments on the value of being able to post assignments to Domino, rather than having to travel to campus to hand them in. Others noted that Domino facilitated interaction with team members. All of these comments can be interpreted to be related to the relative advantage of using Domino.

Even more interesting is to look at comments related to compatibility. Many subjects either praised the ability to work from home, or lamented the necessity to travel to a campus computer lab to use Domino. At first glance, these seem contradictory. However it appears that subjects who had Web access at home and were used to accessing information through the Web found Domino to be compatible with their work habits, while those without Web access from home found Domino less compatible.

Perhaps more revealing are comments regarding preferred communication styles. A number of students mentioned how Domino allowed them to interact with others even though they were reluctant to speak up in class. For example, one subject speaking about what they liked about Domino stated, "It was easier to 'talk' about things without feeling put on the spot the way I sometimes feel in a classroom." Others commented that they would rather interact face to face than through Domino. These comments seem to be related to perceived compatibility. Some commented on the degree to which communicating through Domino is more or less compatible with their communication preferences.

From the results it is clear that result demonstrability plays a role in adoption intention. This validates Moore and Benbasat's (1991) contention that the traditional innovation characteristic of observability is actually two constructs: result demonstrability and visibility. The findings of this study clearly illustrate this distinction since result demonstrability is highly significant ($p=0.014$) while visibility is clearly non-significant ($p=0.601$).

The results are also telling with regard to perceived complexity. While perceived complexity is a significant term in the model, it has the weakest association with adoption intention. In the case of Domino, perceptions of complexity are less important than those of relative advantage, compatibility or result demonstrability. This result may be surprising to many who feel that user friendliness is *the* critical factor in determining use. These results indicate that other factors may be even more important.

This finding is particularly interesting in light of the much-studied Technology Acceptance Model (TAM) (Davis, 1989). According to the results of this study, it may be that the TAM is not sufficiently detailed. TAM, which in its basic form indicates that ease of use and usefulness determine use and/or intention to use, does not consider other factors such as compatibility and result demonstrability. In the case of this research, compatibility and result demonstrability both exhibited stronger associations with adoption intention than complexity, which is the conceptual opposite of ease of use (Moore & Benbasat, 1991). Perhaps researchers and change agents dealing with certain technologies would be better off to use diffusion of innovation theory as their basis.

Change agents interested in increasing the use of groupware technologies, including Domino discussion databases, may find that taking actions that impact the significant factors might influence adoption decisions. Researchers interested in the adoption and use of groupware technologies may use this study as a starting point to further investigate this area. Future research may include using experimental methods to examine causal relationships, or may replicate the present study to investigate specific groupware technologies other than Domino discussion databases. Such extensions of these findings will help to increase our knowledge of the diffusion, adoption and use of groupware.

Change agents may also be interested in particular actions and methods that may help influence perceptions of groupware in a manner that encourages its use. The following section provides a number of such actions and discusses them in the context of their impact on users' perceptions. Note that the following discussion draws from the authors' experiences as well as the data gathered for this study.

Lessons Learned

As demonstrated by the empirical test of the research model, groupware use is greatly influenced by users' perceptions of the technology. So, it is important that efforts be taken to ensure that potential users have a positive perception of groupware. One aspect that can quickly have a negative impact on perceptions is a poorly functioning, unreliable groupware system. Having a sound technology infrastructure in place for the groupware system is critical. For example, adequately performing servers and a fast, reliable network should be viewed as requisite for the use of groupware. If users have difficulty accessing the groupware system, it is likely that perceptions of relative advantage and complexity will be impacted in a manner that negatively impacts use intentions.

In educational settings, it is also important for instructors or facilitators to pay close attention to the quality and frequency of early, class-related discussion database postings by students. Encouraging students to make frequent, proper use of the groupware system is likely to increase perceived relative advantage for most users. If only a relative handful of users utilize the system, the value of this utilization is less than if a larger number of users provide meaningful postings.

Another factor that change agents should consider is their own use of groupware. For example, in an educational setting, it is important for instructors to make full use of the groupware system. Otherwise, a message is sent to other users that the system is not valuable, which is likely to have a negative impact on perceptions of relative advantage. If the instructor does make use of the system, the opposite message is sent, increasing perceptions of relative advantage.

Providing users with an un-intimidating introduction to the groupware system may impact perceptions of complexity. For example, posting interesting, provocative topics to a discussion database may engross users in a discussion and help overcome any trepidation some users may have about their ability to use the system. Such playful use of an application is thought to lead to learning that can be applied to other, more serious uses of a technology (Belanger & Van Slyke, 2000). Of course, providing training and technical assistance to users can also impact users' perceptions of complexity.

Perceptions of compatibility are also important determinants of use intentions. Care should be taken not to inadvertently take actions that negatively impact perceived compatibility. A consistent look and feel of the groupware system should be maintained for different applications. For example, an individual user may be a member of multiple teams that use different applications of a groupware system. If a consistent look and feel is maintained across the applications, users with experience with one application of groupware are likely to feel that a new application is compatible with their past experience. Even something as simple as changing font styles or colors can have a negative impact on perceived compatibility.

LIMITATIONS

This research, like any study, has a number of limitations of which readers should be aware. One limitation stems from the methodology used. This research demonstrates that there is a relationship between several perceived innovation characteristics and use intentions. However, a causal relationship cannot be claimed since there were no experimental controls. Further research is necessary in order to investigate causality.

A further limitation results from employing intention to use rather than actual use. Although, as discussed earlier, there is extant evidence of a relationship between intentions and actual behavior, establishing a relationship between actual use and perceptions of innovation characteristics requires additional research.

Care also must be taken when extending the findings of this research. This study investigated a specific groupware technology, Lotus Domino discussion databases. Only further research can verify whether these findings hold for other groupware technologies. In addition, this study occurred in an educational context. This raises two issues that can only be addressed through future research. First, it may be reasonable to expect that these findings hold in the context of industry-based training. However, assessing the validity of this expectation requires additional investigation. It is less clear whether the relationships exhibited hold in other industry contexts. For example, additional research might use this study as a model to investigate the use of groupware in the support of workgroups.

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Chapter XIII

The Influences of the Degree of Interactivity on User-Outcomes in a Multimedia Environment: An Empirical Investigation

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ABSTRACT

The study reported here investigates the influence of "interactivity" on the learning outcomes of users in a multimedia systems environment. Drawing from past literature base and based on key tenets of three learning theories, behaviorist, cognitivist *and* constructivist, *the study first proposes a measurement scheme for "interactivity" and then hypothesizes that "interactivity" would influence the learning outcomes positively in terms of users' learning*

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achievement and attitude. Three prototypes of a multimedia instructional/training system to represent high, low, and non-interactive modes of use were developed and implemented, and the hypothesized influences were investigated using a controlled laboratory research design. Multiple analysis of variance (MANOVA) results indicate that while interactivity does not necessarily enable enhanced gain in user learning, it positively influences participants' attitude. The study finds no support for hypothesized moderating effects of learning styles (measured using Kolb's Learning Style Inventory scale) on the relationship between interactivity and user outcomes. The results of this study have important implications for both education and corporations' training efforts and investments. The reasons for practical lack of influence of learning style are highlighted in some detail. Implications and future research directions are discussed.

INTRODUCTION

Corporations, as well as other organizations, such as educational institutions, have been exhibiting significant interest in recent years in multimedia training and instructional systems. The primary motivating factors appear to be reduced costs, flexibility in training and more consistent delivery among others. This has been fuelled further by a call for continuous professional development that demands a constant and consistent updating of one's professional knowledge throughout his or her working life, especially in an environment that displays a climate of rapid technological, social, economic and political change (Sadler-Smith, Allinson & Hayes, 2000). Such knowledge/ education/training demands call for innovative means of instructional delivery including learner autonomy and self-directed life-long learning. Interactive multimedia instruction (IMI) systems is a relatively new instructional technology that falls into this realm and has become possible by recent advances in both hardware (i.e., multimedia computer technology), software (e.g., authoring software) and network (e.g., delivery via the Internet/Web) technologies. IMI is related to computer-assisted instruction that has been widely used for over 20 years and to video-based instruction that has been introduced more recently.

While printed materials, TV and computers employ text, pictures and diagrams to support and to facilitate learning, only TV and computers provide a medium to use sound and depict motion. Computers can be used to further aid learning due to their capability to process, transform and proceduralize information. Available research on multiple versus single media does not support the claim that the former has significant advantages in enhancing effectiveness in learning (Clark, 1992). However, the capability of a multimedia system, in conjunction with methods that enable learner control, interactivity and hypermedia structure, is posited to have positive impact on learning (Gay, 1986; Kinzie, 1990; Kozma, 1991; Schaffer & Hannafin, 1986). While applications of and research on hypertext/hypermedia have grown in recent years, few studies exist on the "degree of interactivity" provided by these media; what exists is mostly about interactive video instruction (IVI).

Careful analysis of the existing literature base, including learning theories (discussed in the next section), indicates that the literature is quite sparse in identifying the degree or type of interactivity that would be appropriate in the context of learning (Cronin, 1992). In this study, we present "interactivity" as a key characteristic of an educational medium or a method for instruction while using multimedia computer systems. We primarily investigate what influence "degree of interactivity" has on students' achievement and attitude. The findings of this study would be extremely helpful both for real-world corporations and educational institutions in their decision of whether or not it is beneficial to make the large-scale investments for computer-based interactive multimedia instructional and training systems.

The chapter is structured as follows: the first section briefly presents the theoretical framework, discussing the concept of interactivity, underlying learning theories and their implication for the design of IMI systems. The research model and hypotheses are then developed, followed by a discussion of the research design and operationalization of the variables. The results of data analysis are offered. The results and their implications, and directions for future research, are then discussed, followed by a conclusions section.

THEORETICAL FRAMEWORK

Interactivity Within a Learning Environment and its Relevance

Before discussing interactivity, we would point out that this concept will be linked to three key theories of learning: *behaviorist* (Skinner, 1954), *cognitivist* (Wertheimer, 1959) and *constructivist* (Piaget, 1977); these will be discussed in some detail later in this section. Briefly, it is to be noted that the objective/emphasis of each theory is somewhat different. The *behaviorist* theory's objective is to understand *what learners do*. This theory lays its emphasis on how to retain and change target behaviors through suitable "stimulus-response" tactics. Reinforcement via feedback, and (varying levels of) learner control are the two of the most common mechanisms of behavior control and management. The *cognitivist* theory's objective is to understand *what and how learning takes place.* This theory lays its emphasis on how to ensure efficient and effective transfer of knowledge to the learner. Attention to motivation, attitude change, anxiety reduction and easy/flexible access are some of the key mechanisms. Finally, the *constructivist* theory's objective is to understand *how to make learners think and learn more productively.* This theory emphasizes discovery-based learning and bringing out learners' personal experiences and interpretations. System flexibility and encouraging "active" user inputs and participation are some of the key mechanisms.

In a traditional sense, interactivity applies to face-to-face communication and learning in a classroom-type environment. It has been suggested (and is easy to recognize) that learning can also occur in other (interactive communication) settings such as talk shows on radio, two-way cable systems, electronic mail and even interactive video games. Within the context of communication technologies, Rogers (1986) defines interactivity as the degree to which the technology can support or enable interaction that resembles human conversation and has proposed a continuum of interactivity. Under this definition, face-to-face communication is the most interactive mode where the instructor is able to provide immediate clarification, necessary motivation, personal attention and ensure better student learning. On the contrary, electronic mail offers some interactivity and television supports little or no interactivity.

Using Laurel's (1986) concept of *first-personness*, interactivity can be interpreted as the degree to which a system exhibits first-personness. The three interactive aspects of first-personness are frequency, range and significance. Interactive frequency is a measure of how often user input or output is enabled. Interactive range denotes the choices available to a user at a given moment during the interaction; for instance, a "yes-no" or any other binary choice has a very narrow range. Finally, interactive significance is a measure of the impact of a user's choices and actions upon the outcome or experience in an interactive session. Previous research posits that an instructional system that offers greater frequency of interaction and wider range of choices will more actively engage the learner during the session and, to the extent that the system clarifies the link between their choice and the consequent outcome, motivate the learner to perform better.

Weller (1988) defines interactivity as a characteristic that allows learners to adjust the instruction to conform to their needs and capabilities. In such a process, learners becomes active participants, making key decisions. There are a number of features of learner control, the most common being the control of instructional pace and sequencing/branching. For instance, systems offering learners the ability to control the sequence of the instructional material and set the pace will allow them the freedom to assign appropriate amount of time to each learning-module, review and, when necessary, repeat certain modules. Interactivity, incorporating learner control combined with suitable feedback, can instill and reinforce positive attitude, and enhance performance (Hannafin & Rieber, 1989).

Several other scholars offer their own interpretations of what interactivity is and how to apply it in designing instructional systems (Borsook & Higginbotham-Wheat, 1991; Cohen, 1984; Giardina, 1992; Jonassen, 1985; Weller, 1988). Cohen (1984) suggests that interactive instructional systems should not only have features of learner control but also accommodate different learning styles and capabilities. Learning style differences may occur in terms of the nature of learning and interaction (e.g., active, hands-on versus passive, observer), speed (e.g., fast versus slow) or information content (e.g., holistic versus detailed) (Kolb, 1973, 1984; Mumford & Honey, 1992). Sophisticated types of feedback can be provided; for example, a feedback that offers remediation by branching back for review or one that is flexible and offers alternate sequences. The instructional system could also locate incorrect responses and inform the learners why they are wrong, and suggest how to correct them. The quality of interaction may be assessed in terms of the type of input required of the learner during the interaction, learner's response and consequent feedback, and the paths followed by a fast versus a slow learner. It has been suggested that responses from the program should be immediate to be of use in enhancing learning.

From a cognitivist view, for instance, progression from novice to expert phase can be used to match the learner's cognitive state and learning aids offered to promote selection, organization and integration of new knowledge (Hannafin, 1989). From a constructivist's view, Jonassen (1990) suggests that instructional technology should have application tools such as databases, expert systems and hypertext that can be employed by learners as knowledge construction tools to help them think more productively. For instance, hypertext systems can facilitate cognitive flexibility by allowing a specific topic to be explored in multiple ways using many different concepts or themes (Spiro & Jehng, 1990).

Thus, from the foregoing brief discussion, it can be noted that interactivity has been discussed in various ways and is, perhaps, still more of an art than a science. However, if designed properly, interactivity in instructional systems may be able to provide support to different types of learners and in each case offer suitable levels of learner control, feedback/reinforcement, flexibility, experimentation, range of choices and practice—all of which can enhance better learner attitude and learning performance. In the rest of this section, we discuss the implications of the three theories of learning for interactive multimedia systems and how these tenets can be employed in effectively designing such systems.

Implications of Theories of Learning for Interactive Multimedia Instruction System

Significant guidance for the design and development of Interactive Multimedia Instruction (IMI) systems can be drawn from past research and theories on human learning and cognition. As noted briefly, each of the three key theories of learning —*behaviorist*, *cognitivist* and *constructivist*—has a different emphasis for the design of instructional systems.

Skinner, one of the best-known and most influential psychologists in the *behaviorist* tradition, demonstrated the principles of operand conditioning and how they could be successfully applied to problem solving and to classroom situations (Skinner, 1954, 1958, 1968, 1973). From a behaviorist's perspective, reinforcement brings about learning; responses that are reinforced tend to strengthen and increase in frequency. Learning can be shaped by selective reinforcement, either as motivational and/or correctional feedback, to increase the likelihood of target behaviors. Another tenet of this theory is "mastery learning," where each learning segment must be mastered before moving to a new one. However, a criticism of behaviorist approach is that it is too narrow and cannot completely explain the complexities of human learning. Application of its principles often leads to programs that concentrate on development of low-level skills at the expense of complex, conceptual behavior (Chase, 1985). Also, poorly developed instructional software could result in inadequate application of behaviorist principles. On the other hand, its basic principles, such as the use of feedback, self-pacing and sequencing of programs, can be successfully used within other paradigms (Hannafin & Rieber, 1989).

To *cognitivists*, learning is concerned with what learners know and how they acquire it, rather than what they do, the primary concern of behaviorists. Many ideas and assumptions of cognitivism can be traced back to the gestalt psychology,[1] one of the several rival schools of thought. Gestalt psychologists emphasize the importance of organizing learners' processes in perception, learning and problem solving. Learning, in this view, depends on perception and involves reorganization of an incomprehensible collection of things into things that make sense. While the understanding of a general principle can be easily applied to many different situations it fits, rote memory (one of the thrusts/outcomes of behaviorists) is unlikely to be transferred to new situations. Thus, a primary goal of instruction from a cognitivist perspective is to transfer knowledge to learners in the most efficient and effective manner.

Cognitive learning models isolate mental processes in order to find efficient mapping of "external reality" in learners. The underlying assumption is that learning is composed of processes that represent reality. This philosophical position is labeled as objectivism (Jonassen, 1991). A drawback of these models is that although program designers might attempt to analyze, decompose and simplify the complexity and irregularity of learning tasks, the resultant design of learning tasks could be misrepresented. However, several cognitive learning foundations, such as short-term and long-term memory (e.g., encoding and retrieving) and states of knowledge, provide a number of guidelines for design of instructional applications. For instance, progression from novice to expert phase can be used to match the learner's cognitive state and learning aids offered to promote selection, organization and integration of new knowledge (Hannafin, 1989).

Piaget's approach to learning, called *constructivism*, investigates the spontaneous and self-regulated learning found in natural, untutored concept formation (Forman, 1980). While Skinner argues that learning is a change in reinforced behavior, Piaget insists that meaningful learning results only when a person reflects — that is, from the thoughts of the learner and not from the environment. In this theory, in addition to external (social and physical environment) determinants of learning, there exists a process of equilibration — how the person organizes pieces of information into a non-contradictory system of knowledge (Piaget, 1977). Gestalt psychologists have also studied how humans organize what they see; while a common theme appears to be that the mind perceives things as an organized whole, Piaget posits that the whole is not an "innate given" but that it is constructed through an interaction with the environment.

Learners, in this view, determine reality based on their experiences and interpretations as contrasted with the externally mediated reality of objectivism of cognitivists. Thus, a constructivist's view of learning is that it is a constructive process in which the learner builds an internal representation of knowledge as a personal interpretation of his/her experience and determines reality (Bednar et al., 1991). Jonassen (1990) suggests that constructivist approaches to instructional technology need application tools such as database, hypertext and expert systems that can be employed by learners as knowledge-building tools to help learners think more productively. For instance, hypertext facilitates cognitive flexibility by allowing specific topics to be explored in multiple ways using a number of different concepts or themes (Spiro & Jehng, 1990).

The foregoing discussion of *interactivity* and the three theories of learning point to the relevance of interactivity to learning, and that each theory has a number of benefits and some weaknesses, with no one theory being superior than others. Successful implementation of an IMI requires as a foundation an instructional theory that embodies key aspects of all these theories, and is used to match the goals of instruction and the context of learning.

IMI System Features and Their Implementation

The brief discussion of the three learning theories points to the following key tenets for enhanced learning. *Behaviorist theory* emphasizes the importance of reinforcement and learner control (e.g., via feedback, (self-) pacing, sequencing and overt responding of the instructional system to the users). *Cognitivist theory* indicates a need for support from the system to aid efficient transfer and retention of knowledge to user's short-term as well as long-term memory. *Constructivist theory* highlights the need for the system to foster in users the ability to explore and discover knowledge.

Mapping these key tenets of learning theories with notion of interactivity, we define interactive features for an IMI system in terms of the following broad guidelines:

- It should allow the users to adjust the instruction to conform to their needs and capabilities.
- It should allow the users to become active participants in making significant decisions about their learning environment.
- It should allow easy interaction actions such as confirmation, inquiry and pacing.

These broad guidelines must be translated into more specific design features that, in turn, can be implemented as specific functions or features to characterize an IMI environment. The interactive features of such an environment (that were also built into the IMI system developed for this research) have been briefly outlined below.

- Reinforcement Concept through:
  - ***Feedback***: To strengthen user learning via verification. Errors (made by users) to be identified (by the system), users to be informed of reasons for their occurrence and corrective actions may be suggested.
  - ***Learner Control***: To offer users the capability to control instructional sequence, pace (time spent on learning), review or repeat instruction and selection of contents covered.
  - ***Learning Progress Summary Statistics***: To help learners with self-monitoring by assessing their overall performance. Research shows that learners who monitor their progress perform better than those who do not (Cook & Kazlauskas, 1992). This may also increase their level of self-confidence (and thereby reduce the anxiety, a theme of cognitivist theory).
- Enable Efficient and Effective Transfer of Knowledge through:
  - ***Questions and Clarifications***: To encourage and enable users to ask questions and seek clarifications on specific subjects, topics or words (e.g., hot spots).

- ***Examples and Practice***: To enable users to practice as often as necessary because practice is important in the learning of facts and problem-solving skills. Also, build-in realistic examples to help learners develop necessary concepts.

• Foster Flexibility and Discovery-Based Learning through:
- ***Hypermedia Structure:*** To permit browsing, set up nodes of information, establish links between related nodes of information and enable different paths of navigation.

The central tenets of the various learning theories, their translation into key design features and how these have been mapped into the systems' features are illustrated in Table 1.

Within the context of interactive computer-based instruction, the learner and the program are in a state of continuous dialog through the use of interactive features such as those noted above. In this study, drawing upon Laurel's ideas of first-personness (Laurel, 1986), we identify three dimensions that would represent the degree of interactivity: (1) *frequency* (of user input or system response), (2) *range* of choices (of interactive features available to a user) and (3) *modality* of (transformation/presentation of) information. These three dimensions of the degree of interactivity were implemented in varying degrees into three IMI prototype systems developed for investigation in this study.

The first dimension, *interactive frequency*, is a measure of how often a user's input to or response from the system is enabled. Throughout the instruction session, user input or response can be established by using a number of interactive features described earlier (e.g., the number of times learners are allowed access to the system to work on practice questions in a particular section during a specified unit of time).

The second dimension, *interactive range*, is the range of choices available to a user at a given time during the interaction. The interactive range would be narrow, for example, if the environment provides only with "right-wrong" or "true-false" responses. On the other hand, a high interactive environment would offer a range of different types of responses. For instance, the system could respond to user questions with (a) correct-incorrect choice, (b) an explanation of the answer, (c) choice to repeat the instruction, (d) a choice for more questions, or (e) a choice for on-line contextual help.

The third dimension, *modality*, is defined as the use of different sensory systems both by the program environment and the learner. For example, inputs by the user to the system might be in the form of keyboarding, a touch screen or voice

Table 1: Mapping of Learning Theory Concepts to Systems Features

Learning Theories/Concepts	***Design Concepts***	***Systems Features*** @
Behaviorist Theory focuses on "what" learners do and how to retain/change target behaviors: ▪ Reinforcement	▪ Immediate or Delayed Feedback (motivational and/or correctional) ▪ Learner Control	▪ Verification/Confirmation (positive or negative)/Error-reporting ▪ Learning Progress -- Summary Statistics ▪ Self pacing ▪ Sequencing or branching → Control over the range of material content; depth & difficulty of material studied; type of media (e.g., text, pictures); time spent; amount of practice
Cognitivist/Objectivist Theory focuses on "what" and "how" learning takes place, and how to ensure *efficient* and *effective transfer* of knowledge	▪ *Sensory control* – Attention & perception ▪ *Affective dimensions* – Motivation; attitude; values; anxiety; emotions & feelings ▪ *Short-term memory* – Encoding; storage; retrieval; maintenance ▪ *Long-term memory* – Content; skills; strategies	▪ Questions ▪ Practice; Review/repeat instruction ▪ (Realistic) Examples ▪ Navigation via "buttons" and "menus" (even if learners are exposed to predetermined sequence & pace, and small chunks of material); providing suggestions, hints and examples, and on-line help, elaborative feedback
Constructivist Theory views learning as a "constructive" process and focuses on how to make learners "think" and "learn" more productively: ▪ Personal experiences and interpretations ▪ Discovery-based learning ▪ Situated cognition	▪ Flexibility ▪ Encourage "active" inputs & participation from learners	▪ Hypermedia structure based navigation ▪ *Hot spots* (e.g., that provide greater detail on that topic and/or newer, additional interesting information on related topics)

@: These Features Designed to Differ Across the Three Levels of Interactivity on Frequency, Range and Modality

input. Also the program environment itself can use different response modes during a presentation such as voice or sound, animation, graphics or video. Multi-modality emerges from the capability of a medium to present and transform information in various symbol systems such as text, audio, graphics and video. Media channels and language variety are two attributes that support higher interaction. Because multimedia allows both visual and audio channels during interaction, language variety or multiple cues can be enabled as part of the messages. Examples of cues are: (a) audio and video images taken from real-life situations; (b) written words, speech and other symbols such as graphics, all of which can be represented simultaneously.

The two attributes (channel and language variety) and the capability of IMI in incorporating immediate feedback and personalization of messages provide "richness" of processed information (Daft & Lengel, 1984, 1986; Daft & Trevino, 1987). Daft and Lengel (1984) define richness as the potential information-carrying capacity of data, based upon a blend of four criteria (instant feedback, multiple cues, language variety and personal focus). Zack (1993) identifies a similarity between richness and interactivity, where interactivity is considered as the degree to which the technology can support interaction that resembles human conversation. Multimedia instructional systems possess the characteristics of a rich medium (Lim & Benbasat, 2000) and are capable of supporting or enabling interaction that can approach face-to-face communication, the highest form of interactivity as posited by Rogers (1986).

The relationship between interactive features (grounded by the tenets of the three theories of learning) and the degree of interactivity for an IMI environment is shown in Figure 1.

Within this setting, we visualize that these interactive features support and enable interactivity in the learning environment. Since each IMI offers a continuum of interactivity, we need to consider the degree to which interactivity facilitates a particular type of learning. In general, a more interactive instructional system enables a higher frequency of use of interactive features and makes available a wider range of choices to the user at a given time during the interaction, and offers the flexibility of presenting the instructional content in multiple modes. Figures 2 and 3 represent this graphically.

Figure 1: Learning Concepts, Systems Features and Degree of Interactivity

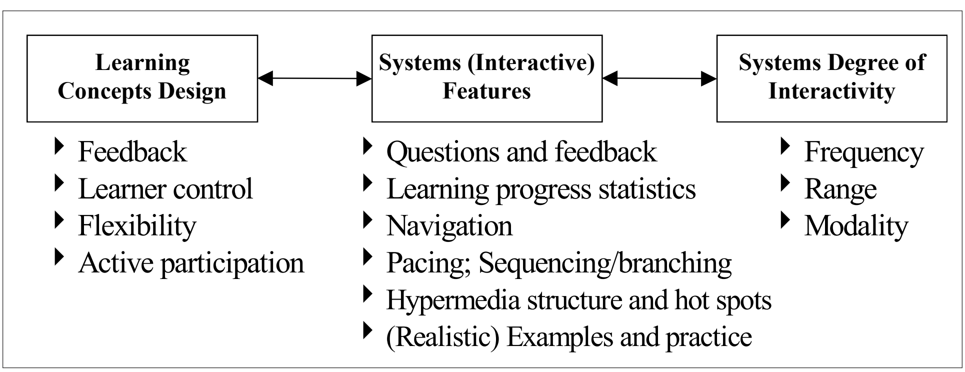
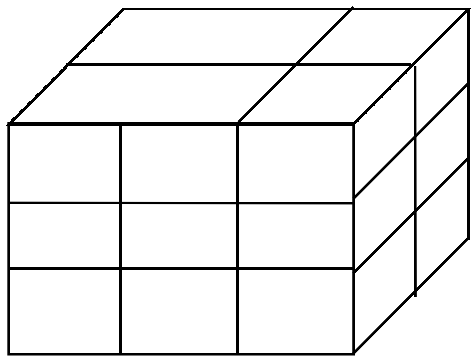
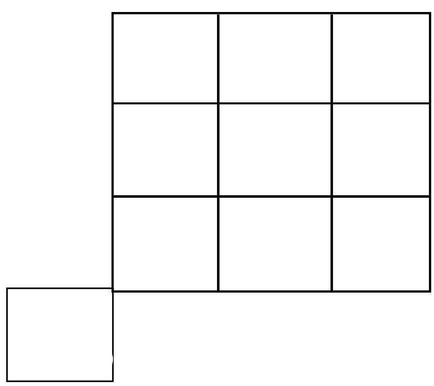


Figure 2: High Versus Low Degree of Interactivity



It follows that the three dimensions of interactivity give rise to 18 cells. Because the content of the instructional program chosen for this research is about multimedia technology (that may be equated to a *relatively structured task*) and a multimedia system was used for delivery of this content, the modality dimension is multiple. Thus, we are concerned with 9 cells[2] as represented by Figure 3.

Figure 3: The 10 Cells Representing Degrees of Interactivity (For This Study)



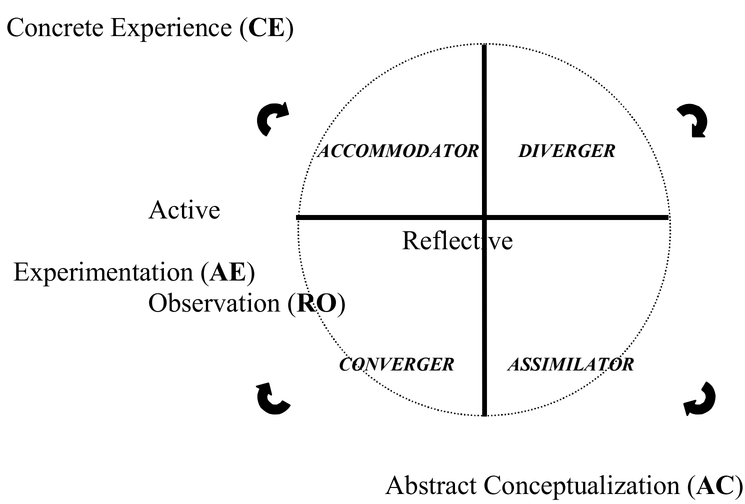
RESEARCH MODEL AND HYPOTHESES

Research Model

Before the research model and the study's propositions are laid down, we believe a caveat is in order to dispel any notion that a high degree of interactivity is always needed or desirable. The nature of the task/learning can influence the nature of information that is required, and hence the extent of systems success as observed in past research in IS literature (Guimaraes et al., 1992; Sanders & Courtney, 1985). Notwithstanding mixed findings in past research, task structure, task difficulty, task uncertainty, task variety and task interdependence are key components to be considered. For instance, it has been suggested that more structured and less difficult tasks require less complex information and simpler user interface, thereby leading to greater system success and user satisfaction. On the other hand, more task uncertainty, variety and interdependence lead to significant cognitive burden, user frustration and system failure. It is thus possible that the nature of the task (e.g., more complex task) might demand a different (higher) degree of interactivity in the environment. However, within the limited context investigated in this study, namely a learning environment rather than problem solving or decision making entailed in a business context, task characteristics are expected to play a less important role.

Because IMI offers an opportunity to individualize instruction, the instructional environment is designed in a way to give users a significant degree of control of the learning process. That is, to some extent, the users customize IMI according to their own individual preferences and style. Due to such customization capabilities, the

Figure 4: Kolb's Learning Style Grid (Kolb, 1976)



learning style of individuals can assume a key role in the learning process in an interactive learning environment. Some research exists in the educational literature that has investigated the relationship between learning style and effectiveness of computer-based training; but the results have been conflicting (Burger, 1985; Larsen, 1992). Research in information systems has found that individual differences in learning style do have some intervening effects on the learning outcomes in end-user training (Bostrom et al., 1990; Davis, 1990).

Kolb's *experiential theory of learning* (Kolb, 1976, 1984, 1985) has received considerable attention in the management literature (Hayes & Allinson, 1993). As displayed in Figure 4, this model postulates that people progress through a four-stage cycle of learning where "concrete versus abstract" and the "active versus reflective" dimensions are polar extremes.

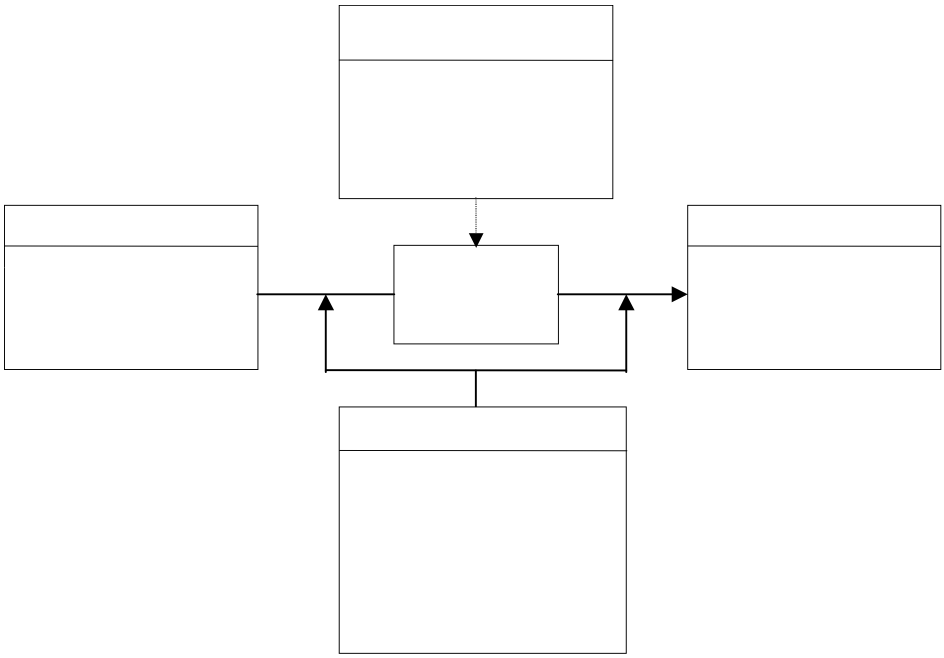
Individuals are believed to usually start with *concrete experience* (CE) of a phenomenon that is followed by *reflective observation* (RO), leading to *abstract conceptualization* (AC) that, in turn, leads to *active experimentation* (AE) on a recurrent basis. The model further assumes that an individual's relative emphasis or preference for particular stages is based on his/her past experiences and current goals. Kolb's measure of learning style is a self-descriptive questionnaire called the Kolb Learning Style Inventory (KLSI). The dominant learning styles identified in the KLSI are *diverger, assimilator, converger* and *accommodator*.

The Myers-Brigg instrument, a competing measure, has been used to classify people into specific cognitive types (e.g., sensitive versus intuitive; thinking versus feeling) in their information acquisition, evaluation and use (O'Brien, 1999; Ramamurthy et al., 1992). However, unlike the Myers-Brigg instrument that has been developed for and used in a number of general situations, Kolb's KLSI (Kolb, 1985) has been developed exclusively for learning environments. It is an established and validated instrument that is also short and easy to administer and score (Simon, 2001). Therefore, we chose to utilize Kolb's LSI to measure learning style in this research. Furthermore, KLSI aims at identifying a relationship among instructional strategy, learning style and learning performance, which is of relevance to our research framework. Kolb's theory has been quite widely adopted by researchers and practitioners providing evidence to support his proposition (Bostrom et al., 1990, 1993; Hayes, 1993; Kolb, 1973; Sein & Robey, 1991).

Based on the foregoing discussion, we postulate that the learning outcomes would be influenced differently under varying degrees of interactivity (represented in Figure 3) and that these would be contingent on individuals' learning styles (of Figure 4). The research model is shown in Figure 5.

The research model (and the hypotheses proposed later) are grounded in the theory underlying learning and based on the extant literature about the design of an interactive instructional program (interactive features) and the degree of interactivity.

Figure 5: Research Model



As noted earlier, the design of IMI is rooted in the behavioral, cognitivist and constructivist learning theories and paradigms. To recap, we have included the use of feedback (for reinforcement), self-pacing and sequencing of programs (for self-control) as suggested by the behaviorists. Based on the cognitivist's paradigm, we have included the use of practice, questions, (realistic) examples and (elaborative) feedback to serve several functions. For example, 'questions' serve three general functions in learning: (1) to establish and maintain attention (sensory control), (2) to facilitate encoding, and (3) to provide for rehearsal and reduction of anxiety (Wager & Mory, 1993). 'Practice' and 'feedback' facilitate the transfer of both knowledge- content and skill to long-term memory. Drawing from the constructivist paradigm, we have included the capabilities of exploration and discovery via hypertext links.

We pointed out earlier that significant potential could exist for interactivity to influence the learning process and learning outcomes. Higher levels of interactivity would enable the subjects to become active learners, counter passivity by increasing the perceived demand on the learners for their inputs and raise the amount of mental effort required to learn in an interactive environment (Salomon, 1983). More frequent feedback, evaluation of realistic examples and practice aid in the transfer and encoding of knowledge, besides reinforcing what is already learned.

Thus, it is expected that students can be expected to perform better when using a more interactive computer-assisted instruction system because of the interactive features it provides to support learning.

It is further expected that students' learning styles may moderate their learning outcome depending on the mode of the interaction. For example, *accommodators* (in the quadrant intersected by active experimentation and concrete experience) who have an ability to learn primarily from "hands-on" experience or "learn by doing" may derive greater advantage from the interactive features that are offered. But *divergers* (in the quadrant intersected by reflective observation and concrete experience) who like to observe rather than take action may not. Some recent research also suggests that *assimilators* and *divergers* may prefer a more guided instruction, while *convergers* and *accommodators* may benefit more from a discovery mode. Hence the following two hypotheses involving learning achievement/performance are proposed for examination:

H_1: Greater degree of interactivity will have a positive influence on learners' achievement level.

H_2: The (above-noted) relationship between interactivity and learners' achievement will be influenced by learning style; that is, the interaction of learning style and interactivity will have an effect on learning achievement.

It is also expected that subjects who are offered a higher degree of interactivity will display better attitude towards the material to be learned, the system and the learning experience. A greater level of interactivity has the potential to make the learning experience more interesting and stimulating. However, regardless of the access and the opportunity to experiment with a number of interactive features, individuals with different learning styles may prefer a specific mode of interaction than others. For instance, as noted earlier, both *convergers* and *accommodators* may favor the *active-experimentation* learning mode; thus, such a learning style may further strengthen the (already existent positive) relationship between the degree of interactivity and user attitude. Thus, the following two hypotheses relating to learner attitude are proposed:

H_3: Greater degree of interactivity will have a positive influence on learner attitude.

H_4: The (above-noted) relationship between interactivity and learners' attitudes will be influenced by learning style; that is, the interaction of learning style and interactivity will have an effect on learner attitude.

RESEARCH DESIGN

The IMI Prototype Systems

Using the concept of interactivity developed earlier (and the design features outlined in Table 1), three different versions of a multimedia instructional system with varying degrees of interactivity were implemented. As pointed out, the degree of interactivity contains three key dimensions: frequency of user input or system response, range of choices of available interactive features and multi-modality of the program. All three versions were developed for (IBM-compatible) multimedia computers under Windows environment. Several software packages were used to develop these interactive systems, including authoring software (Authorware Professional), image and sound-editing software, and clip art (including sound, photographs and video). While modality was restricted to text, image and graphics for the *non-interactive* version, sound and video were included for the other two versions. The nature of control and linkage for the *hot texts* (via hypermedia links) were designed and implemented differently for each version. The prototypes were modified a number of times so that the design features (representing the learning concepts) were properly captured, and subjected to extensive testing and refinement before deciding to use them for the main study. Necessary training modules were developed, along with videotapes for training the potential participants prior to conduct of the research study. We provide next a brief description of the three prototypes (for more details, see some of the sample screen-shots of the user interfaces for each "interactivity mode" in Appendix 1).

In the ***non-interactive mode*** (used for the control group and denoted as "3" in Figure 3), the subjects could go through the instructional material screen-after-screen only in a linear fashion. They had control of the amount of time they wanted to spend on a particular screen. In addition, a detailed outline (similar to a Table of Contents) was available in this prototype throughout the session to guide the students. Modality of the program was limited to text, image and graphics.

The ***low-interactivity mode*** prototype (denoted as "2" in Figure 3) included some interactive features. Learner control capabilities were provided via the control of instructional *sequence* (i.e., presentation order), *pacing* (i.e., time spent on learning) and *review* or *repeat* instruction. However, the range of control was limited to the use of *next* (right arrow) and *previous* (left arrow) buttons, while a *menu* button was also provided for the users to go back to the main menu at any time. The contents were organized in a hierarchy such that the main menu was at the top level, which the users could make use of to select the topics to view by clicking on any topic at any time in any order. A number of *hot texts* were prepared as examples (using images, sound or video) to help users learn the facts and to help them develop necessary concepts. These hot texts enabled the subjects to explore and to be involved in the learning process. In the low-interactivity version, the frequency of hot texts was few; the modality of the program had all of the multimedia elements.

The ***high-interactivity mode*** prototype included all of the features in the low-interactivity version and several extra features. It was also organized hierarchically, but with a different interface where, in front of each topic heading, there was a check box that automatically placed an "x" when users went through that particular topic. Once subjects clicked on a topic box, they were presented with the topic content. In addition, on each screen a line of text at the bottom of the screen indicated how many screens (or slides) were included on that topic and which slide the current one was. Users could go directly to a particular slide by pressing the slide number instead of clicking the *next* or *previous* button (right and left arrow button). Slide numbers and short descriptions were presented at the top right-hand corner of every screen.

As an integral part of the instruction program, users got feedback from answering multiple-choice questions that were included at the end of each section. Users were provided feedback about their answers whether they were correct or wrong. In the case of wrong answers, they were given information about their wrong choices with reason (i.e., identify the errors and suggest "why"). The *Menu* button was always available. At the end of the questions/answers session, students were provided with their overall performance scores. In addition, there was an index feature where an alphabetical glossary of important terms and concepts were presented. The subjects could click on a particular term that they wanted, and they would be provided with the definition or explanation of that term. The purpose of the index was to strengthen learning via verification. In addition to the extra features, this version of the program had high frequency of hot texts and all of the multimedia elements.

Operationalization and Psychometric Properties of the Study Variables

The independent variable in the study is the varying degrees of *interactivity* of the instructional system. It is an ordinal variable that can assume values at ordered levels or different categories. As noted, we implemented three versions of the IMI system for this research: *low interactivity* was represented by low frequency, low range and multiple modality; *high interactivity* was represented by high frequency, high range and multiple modality. The moderating variable, *learning style*, was measured using Kolb's Learning Style Inventory (Kolb, 1985). Although the "process-boundness" of Kolb's theory has come under some recent criticism (Riding & Rayner, 1998), KLSI is a validated and fairly well-established instrument that has been used in a number of settings (Bostrom et al., 1993; Carlson, 1991); thus, there was no further need to evaluate its psychometric properties.

Students' achievement and attitude are the two dependent variables in this study. *Achievement* was measured as the gain in learning (post-test score/pre-test score). The administration of the actual research study (including the training and experiment phases) is discussed a little later; however, it should be noted that all the subjects took a test prior to start of the experiment session to evaluate their existing knowledge of the subject area. After their training phase and the actual experiment (i.e., interaction with the IMI system), they took the test again and were graded. Both tests consisted of 40 multiple-choice and true-false questions. The tests were identical except in the ordering of questions, and the scores were expressed on a 0 to 100 point scale.[3]

Attitude was measured by a self-reported questionnaire, asking the subjects their perceptions of the various aspects of the instructional program and the quality of the instructional design. There were 29 indicator items, each of which was rated on a 1-5 Likert scale (1 = strongly agree, favorable or highly satisfied; 3 = neutral; 5 = strongly disagree, unfavorable or highly dissatisfied). These items were adapted from the attitude scale developed by Carlson and Falk (1989, 1990, 1991) in the education literature for computer-based instruction, as well as from the various forms of user-satisfaction construct in the IS literature (Bailey & Pearson, 1983; Doll & Torkzadeh, 1988; Ives et al., 1983). This measure needed further assessment of its reliability within the context of this research. Hence, internal consistency of the 29 indicator items representing this variable was evaluated using Cronbach's alpha as the criterion. Cronbach alpha value for this measure was 0.946 (average inter-item correlation = 0.38), with no indication that further improvement would occur to this value by dropping any of the indicator items. Since this value is much higher than 0.60 to 0.70, considered acceptable for exploratory research (Nunnally, 1978), the mean value of all the 29 indicator items was used to represent *attitude* in further statistical tests to evaluate the study's hypotheses.

The Experimental Study

A control-treatment group research design was obviously the most appropriate approach to collect data to test the study's hypotheses. There were three groups: one control group and two treatment groups. The subjects in the control group made use of the *non-interactive* version (indicated as "3" in Figure 3), whereas the subjects in one treatment group made use of the version with *low degree of interactivity* ("2" in Figure 3) and those in the other treatment group used the version with *high degree of interactivity* ("1" in Figure 3). It is imperative to take necessary safeguards to protect against contamination in any research, especially an experimental study, from extraneous influences. In this setting, it was felt necessary to control the instructional content, training of the study-participants and their motivational level to eliminate any potential for confounding of the study's results from such contamination. The precautions taken to ensure such control are briefly described next.

Furthermore, it is possible that (inherently more "intelligent") subjects could outperform their opposites regardless of the interactivity of the system they use. To guard against this possibility, we collected information on their high school and (current cumulative) college grade point average (GPA). A mean of these two GPAs was computed to serve as a proxy for their aptitude, intelligence or expertise level; this is in line with a number of other studies in both IS and education literatures (Guimaraes, 1992). Finally, it is possible, especially for subjects in the "high interactivity" group, to spend more time exploring the "hot spots"; if this is true, it would be necessary to control for this variable in data analysis to avoid contamination of final results.

Given that the objective of the study was to isolate and identify the influence of "interactivity" on learning, we took significant precautions to ensure that all the three versions of the IMI system delivered identical instructional content. The content was an introduction to multimedia technology (including hardware and software). Training was also controlled by having all the participants watch a videotape that walked them through how to use the system by following example screens identical to the actual prototype. The subjects watched one of the three versions of the tape corresponding to their assigned interaction modes. Because the tape was prerecorded, the subjects experienced identical training exposure. During training sessions, necessary help was provided to ensure that they understood the key aspects of the system in general and the instructional software in particular.

The subjects were undergraduate students from an introductory data processing course in the business school of a major Midwestern university. Thus, they had adequate computer knowledge to operate the computerized instructional system developed for this research. They were informed of a need to commit about two hours of their time to learn new material to be presented on a computer. Participation in the study was voluntary. Most students took about 60 to 90 minutes to complete all the tasks. To motivate them to exert their best efforts and perform well, they were informed that they would be automatically entered into a contest to win prizes and that the top nine performers from each version (a total of 27) would be selected based on their performance in a test. To motivate them further, they were informed that they would be using brand-new equipment in the school's new state-of-the-art computer lab. Even though subjects in this study were recruited from a mandatory introductory course for information systems, we discussed with the instructors that they make sure that the course did not cover the domain area involved in this study (i.e., multimedia technologies) to eliminate potential sensitization.

A standard procedure was followed for all the 12 sessions (four sessions each of the high, low and non-interactive modes of interaction) in the research study. Students were randomly assigned to any one of these sessions. Before the experimental sessions, students were briefed on the procedure to be followed. An overview of the tasks to be performed was provided. The same person (following a common script) provided the introduction and all other briefings in every session. The subjects voluntarily signed necessary consent forms explaining the study and its purpose. Students then watched the training tape. At the end of this, the first phase of the experiment began. From this point onward, study participants completed each task at their own pace. Each time a student finished a task, s/he waited for the research staff to give the next task individually. In this phase, instruments to collect demographic data and learning style were given which were followed by the pre-test.

The second phase involved the actual use of the IMI system. During this experimental phase, absolutely minimum help was provided. Each subject's session time was automatically recorded on his/her computer disks. After the subjects indicated their completion of interaction with their system, they were given a post-test and the attitude survey in the last (third) phase of the experiment. Since the study was relatively short, no breaks were scheduled; the participants were thanked and dismissed.

RESULTS

Since there were two dependent variables, Multiple Analysis of Variance (MANOVA) was preferred over individual ANOVA as a more appropriate statistical method to evaluate the study's hypotheses. Prior to testing the hypotheses, we had to make sure that the assignment of students to the three experimental groups, as well as the distribution of the subjects' learning style, were unbiased. This was tested on three demographic variables: age, gender and aptitude. We also needed to check for any differences in "interaction time." Table 2 shows one-way ANOVA results performed on the three variables (age, aptitude and time) and a chi-squared test for the categorical variable (gender).

The results show that there are no significant differences across the three experimental groups, attesting to random and unbiased assignment of the subjects to the three "interactivity modes" or the "learning style" distribution. However, there is a significant difference in interaction time across the interactivity modes (F =

Table 2: Test for Random Assignment

GROUPS	*Age*	*F Value (d.f., Sig. Level)*	*Aptitude* [a]	*F Value (d.f., Sig. Level)*	*Time* [b]	*F Value (d.f., Sig. Level)*	*Gender*	*χ^2 Value (d.f., Sig. Level)*
I. *Modes of Interaction*								
High-Interactivity (n = 49)	21.27 (4.716)	$0.048^{n.s.}$ (df=2,149)	2.996 (0.481)	$0.332^{n.s.}$ (df=2,147)	29.38 (8.92)	22.25^{****} (df=2,150)	Males = 20 Females = 29	$1.007^{n.s.}$ (df=2)
Low-Interactivity (n = 52)	21.25 (4.171)		2.977 (0.371)		22.54 (6.50)		Males = 26 Females = 26	
Non-Interactivity (n = 52)	21.48 (3.562)		2.923 (0.391)		19.16 (5.29)		Males = 22 Females = 30	
II. *Learning Styles*								
Assimilator (n = 49)	20.96 (2.738)	$1.271^{n.s.}$ (df=3,144)	2.979 (0.417)	$0.217^{n.s.}$ (df=3,142)	24.51 (7.65)	$0.186^{n.s.}$ (df=3,145)	Males = 27 Females = 22	$6.419^{n.s.}$ (df=3)
Accommodator (n = 34)	21.50 (5.696)		2.965 (0.419)		23.96. (7.66)		Males = 12 Females = 22	
Converger (n = 36)	22.417 (5.299)		3.010 (0.472)		23.54 (10.44)		Males = 16 Females = 20	
Diverger (n = 34)	20.59 (1.722)		2.928 (0.324)		22.75 (8.01)		Males = 10 Females = 20	

**** $p < 0.001$; *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$; $^{n.s.}$ not significant

[a] *Aptitude* measured as the average of high school and current cumulative college grade point average on 1 to 4 range

22.25, $p<.001$): the "high interactivity" group took significantly more time than the other two groups ($p<.001$), and the "low interactivity" group took more time than the "no-interactivity" group ($p<.066$). Therefore, we decided to run MANOVA using "interaction time" as a covariate. Although not statistically significant, we also used "aptitude" as a covariate to be sure to isolate the true effects of interactivity. Table 3 shows the MANOVA results for hypotheses $H_1 - H_4$.

Overall, the MANOVA model emerges to be significant for the influences of "interactivity," but not for the moderating effect of "learning styles" with "interactivity." Wilks Lambda values are 0.7845 and 0.8959, and F values are 8.646 (df=4, 268; and $p<.001$) and 1.262 (df=12, 268; $p>.10$) for "interactivity" and moderating (or multiplicative) effect of "interactivity X learning styles." These results are after controlling for the significant influences both covariates had on achievement: "interaction time" was significant at better than .01 level ($t=2.915$) and aptitude at better than .05 level ($t=1.989$). Wilks Lambda is 0.8648 and F statistic is 3.504 (df=4, 268; and $p<.01$) for the influence of the two covariates, "aptitude" and "interaction time." Overall, there is no support for H_1 and H_2. However, univariate analysis of the results within MANOVA indicates that the overall mean gain score for "high interactivity" group is the largest among the three groups, although it is not statistically significant ($F=0.907$, $p>.10$). Additional tests (not reported here) indicate that participants in the "high interactivity" group performed significantly better than those in "low interactivity" group; but, there was no difference in their learning achievement compared to "no interactivity" group.

On the other hand, influence of "interactivity" on "learner attitude" is strongly significant ($F=9.997$, $p<.001$), with subjects using the "high interactivity" mode displaying the highest post-test attitude, followed by those in "low interactivity" and "no-interactivity" modes. The results indicate that the two covariates did not have any significant influences on attitude. Finally, learning style has no interaction effect (with interactivity mode) on either learning achievement gain or learner attitude. Overall, these results provide support to hypothesis H_3 but not hypothesis H_4.

Before we move on to discussing the implications of our findings, we deemed it necessary to assess if adequate "power of the test" exists to detect a real effect from the treatment. Extensive research in recent years has resulted in the development of standard tables to identify "power of the test" for various statistics (e.g., t-statistic, Pearson r, F-statistic). Since F-statistic from MANOVA is used in this study, typical assumptions on α, β, f, as recommended in the past literature, were made (see Appendix 2). Along with (actual) $\boldsymbol{u}$ these were used to determine the minimum sample sizes to provide 80% or more power in detecting the effect and not making a Type 2 error (Cohen, 1988; Kirk, 1982). The minimum sample size computations are shown in Appendix 2. Since the primary objective of this research

Table 3: MANOVA Test Results on Learning Achievement Gain and Attitude

LEVELS OF INTERACTIVITY (*MODE*)	LEARNING STYLES (*LSI Categories*) Mean (Standard Deviation) (Cell Size)				*Mean (s.d.) for Overall Interactivity Mode Groups*	*F Value (d.f., Sig. Level)*		*t-Value (Sig. Level) for Covariates*	
	Assimilator (n = 49)	***Accommodator*** (n = 34)	***Converger*** (n = 36)	***Diverger*** (n = 34)		*MODE* [b]	*MODE X LSI* [c]	*APTITUDE*	*TIME*
1. ACHIEVEMENT GAIN[a]									
High Interactivity (n = 49)	20.00 (11.44) ($n_{1,1} = 13$)	19.07 (8.31) ($n_{1,2} = 14$)	23.30 (8.08) ($n_{1,3} = 10$)	23.60 (12.42) ($n_{1,4} = 10$)	20.84 (10.09) (n = 49)	$0.907^{n.s}$ (2, 135)	$1.129^{n.s.}$ (6, 135)	1.989^{**}	2.915^{***}
Low Interactivity (n = 52)	15.58 (9.41) ($n_{2,1} = 19$)	16.22 (10.46) ($n_{2,2} = 9$)	19.53 (10.40) ($n_{2,3} = 15$)	18.00 (15.67) ($n_{2,4} = 6$)	16.98 (10.52) (n = 52)				
None Interactivity (n = 52)	23.31 (15.04) ($n_{3,1} = 16$)	22.91 (9.50) ($n_{3,2} = 11$)	16.91 (10.72) ($n_{3,3} = 11$)	15.54 (11.79) ($n_{3,4} = 13$)	19.77 (12.34) (n = 52)				
Mean (s.d.) for Overall LSI Categories	19.47 (12.17) (n = 49)	19.56 (9.378) (n = 34)	19.78 (9.952) (n = 36)	18.30 (13.00) (n = 34)	19.16 (11.09) (n = 153)				
2. ATTITUDE [a]									
High Interactivity (n = 49)	4.502 (0.315) ($n_{1,1} = 13$)	4.637 (0.213) ($n_{1,2} = 14$)	4.248 (0.526) ($n_{1,3} = 10$)	4.296 (1.162) ($n_{1,4} = 10$)	4.440 (0.607) (n = 49)	9.997^{****} (2, 135)	$0.833^{n.s.}$ (6, 135)	$-0.541^{n.s.}$	$-0.568^{n.s}$
Low Interactivity (n = 52)	4.371 (0.411) ($n_{2,1} = 19$)	4.169 (0.995) ($n_{2,2} = 9$)	4.248 (0.416) ($n_{2,3} = 15$)	3.940 (0.474) ($n_{2,4} = 6$)	4.239 (0.550) (n = 52)				
None Interactivity (n = 52)	3.655 (0.329) ($n_{3,1} = 16$)	3.730 (0.589) ($n_{3,2} = 11$)	3.565 (0.687) ($n_{3,3} = 11$)	3.960 (0.438) ($n_{3,4} = 13$)	3.737 (0.512) (n = 52)				
Mean (s.d.) for Overall LSI Categories	4.169 (0.506) (n = 49)	4.220 (0.719) (n = 34)	4.039 (0.614) (n = 36)	4.075 (0.751) (n = 34)	4.133 (0.627) (n = 153)				
Wilks Lambda [@]						8.646^{****} (4, 268)	$1.262^{n.s.}$ (12, 268)	3.504^{***} (4, 268)	

**** $p < 0.001$; *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$; $^{n.s.}$ not significant

[a] Gain scores range from 0 to100 points; Attitude scores on a 1-5 Likert scale (1 = *strongly disagree*; 5 = *strongly agree*)

[@] Wilks Lambda values are: 0.7845 for MODE, 0.8959 for interacting effect of (MODE X LSI), and 0.8648 for covariates (APTITUDE and TIME) Accompanying F values are approximate except in the case of APTITUDE & TIME, and these are based on Multivariate Tests of Significance

[b] Hypothesis H_1: **direct** effect of *Interactivity Mode* on *Achievement Gain* not supported whereas H_3: **direct** effect of *Interactivity* on *Attitude* **supported**

[c] Hypothesis H_2: **interaction** effect of *Interactivity Mode* with *Learning Style* on *Achievement Gain* and H_4: on *Attitude* **not supported**

was to test effects of "interactivity," the sample size of 153 (high interactivity=49; low interactivity=52; no-interactivity=52) meets the size requirements to provide a power of 0.80.

DISCUSSION AND IMPLICATIONS

Direct Influences of Interactivity

Overall, the results seem to suggest that "interactivity" leads to favorable attitude formation, but not so much to improved learning outcomes. Clearly, a central question would be: Is feeling good about a learning experience" (due to higher interactivity) sufficient? Or should the concern, perhaps, be more on "achievement?" We discuss in detail in this section what could have led to this situation.

Somewhat contrary to our expectations, the results do not provide evidence to support that "interactivity" influences user achievement. There may be several plausible reasons/factors for such a finding. One possible factor may be that the subjects were able to learn basic concepts regardless of the conditions of learning. In this study, the instructional content was factual information related to multimedia technology. Different types of learning (e.g., conceptual learning or problem solving) may yield different results. Different learning contexts (e.g., different subject areas) may influence the outcomes differentially as pointed out in some past research in educational literature.

A second factor is that students' performance achievement was measured almost immediately after the experiment. An important aspect of learning is often *retention of knowledge*; the *process of learning* could very well be a key aspect of what is learned and how well. This is, perhaps, where the maximum beneficial impact of interactivity may have been felt, but not manifested in the measurement; "feeling good about the learning experience" may have triggered more enthusiasm and attention in retaining what was being learned. There is no question that sustained learning seldom occurs without a positive attitude, genuine motivation and enthusiasm for the learning process. In hindsight, we believe it would have been desirable to measure retention of knowledge on the same set of evaluative test material by testing a few days or weeks later; this clearly would be reflective of long-term impacts of learning to examine whether "interactivity" has any significant influences.

A third possible reason for the lack of significant effect of interactivity on achievement may be due to the fact that a strong foundation in instruction (of the subject content) was provided for all three groups. Note that the difference between the mean pre-test scores (43.1%) and post-test scores (62.3%) for all participants in the study was statistically significant. Thus, a case can be made that the instructional program, regardless of the levels of interactivity, influenced achievement positively.

A fourth reason may be that the advantages of interactive features could be better realized if the subjects were given a longer period of time. The users of (any computer) system need more time to familiarize themselves with all of the features in order to use it effectively. The subjects were given only a brief introduction on how to use the system. While they did not seem to have any major difficulty or trouble using the system, only a few might have actually used all of the options. Although no specific time limits were set for the participating subjects, they needed to complete all the experimental tasks within two hours. While we do not imply that students were not given adequate time to learn the basic concepts, we believe that if they were given more opportunity to explore all the available features and options, the advantages of the interactivity might perhaps have been better realized. However, such exploration/discovery-based learning would have led to more time being consumed; some empirical evidence for this phenomenon was reflected (even within the limited timeframe) in this study.

Subjects in the "non interactive" mode consumed the lowest amount of time in completing all the tasks, while "high interactive" mode took the longest time to complete all the tasks. Given the enormous flexibility of and control over the learning process afforded to the subjects in the "high interactive" group, it is possible that extended exploration and experimentation with other interesting details (e.g., using hot spots) may have resulted in some degree of lack of focus and attention in learning. However, there is also research to suggest that, on average, subjects usually gather their informational needs in the most efficient manner possible. Past research has found that traditional instruction mode (with instructors) works better than *exploration* or *discovery* mode in course content that primarily involves rules or general tasks (Hall & Freda, 1982). Therefore, unless the "learning task" is designed to require more discovery-based approach, availability of more time may not necessarily lead to greater exploration and learning achievement.

A fifth reason may be that the students chose not to review some of the content. The user-control option (in the interactive modes) enables them to choose less content to review. If this were indeed true this study, students were likely to do less well. There is some research to suggest that total learner control yields lower post-test performance than limited control, often because subjects with total control terminate the instruction too early (Park & Tennyson, 1980; Tennyson, 1980).

Finally, as noted by Davis and Bostrom (1993), current college students are more accustomed to a very structured learning environment. It is possible that the students in our study might have been more comfortable with the traditional, structured mode of instruction; for such students, greater program than self-control may be needed. The advantages of interactivity may have been mitigated.

Notwithstanding the general lack of direct influence of "interactivity" and some of the plausible explanations provided above, we would recall that, in the "Results" section, we had pointed out that aptitude or expertise and interaction time had direct effect on achievement gain but not on attitude. However, it is interesting to note that while there is insignificant variation of "aptitude" across and not much variation within each "interactivity mode" or "learning style" (Table 2), there is a large dispersion of learning outcome within each of the "interactivity" categories (Table 3). Therefore, we would argue that it is not so much the "aptitude" or "expertise," but rather the system's interactivity features per se (or some other unaccounted for variable) that may be creating differential learning achievements.

Additional subgroup analyses (via Pearson Correlation, not reported here) indicate that "aptitude" has significant effects on "achievement gain" only in the NON-interactive mode ($r = 0.491$, $p < .001$). The correlation coefficients are 0.07 ($p > .10$) for HIGH and -0.131 ($p > .10$) for LOW interactive mode groups. Yet, the effect of positive influence of aptitude (in the NON-interactive mode group) has been sort of neutralized in favor of HIGH interactive mode group. This seems to give credence to our assertion that HIGH interactive mode, with its various features, is able to attract the attention of, offer opportunities to and leverage the synergistic effects of the participants even if they are not (inherently) more intelligent.

If "interactivity" is desirable, a logical question is "how" it can be modified/ manipulated. At a general level, interactivity can be achieved by altering the "frequency" with which the various features can be accessed by the users or, alternatively, in the choices made available to them. The issue of which of these may be easier to manipulate or more appropriate would need to be closely examined in the context of the learning task users are engaged in and the influences each of these can have. This can be more definitively answered only when each of these features is individually manipulated and a more fine-grained evaluation of its effect is carried out in multiple task contexts; this research could not carry out this task. Future research should explore this phenomenon further.

Moderating Influences of Learning Styles

We did not find evidence to support that the learning style influences the relationship between "interactivity" and achievement. The failure to detect significant (moderating) influence of learning styles may be due to several factors. First, other individual differences (e.g., aptitude as discussed above, prior experience, prior knowledge of domain area) may have a stronger effect than learning styles. Second, in the testing of multiple-choice and true-false questions, it is possible for one learning style to have spuriously low scores (Larsen, 1992). In this case, gain scores might not accurately reflect real learning gain.

Another reason may be that the types of learning and learning contexts can have significant impact on individuals with different learning styles. Past research asserts that to achieve optimum results, it is necessary to match courses and materials with learning styles and material content (Simon 2001). For instance, if the material content is more conceptual in nature and the subject's learning style is oriented more toward reflective observation (diverger or assimilator categories), then traditional instruction rather than exploration mode (enabled via "high" interactivity) is probably the best. Carlson (1991) reported that matching students' learning styles with the instruction design led to significantly higher scores for observation skills, but no significant differences in scores on content tests. In our study, however, we did not specifically match the subjects' (dominant) learning style and the interactivity mode with the learning task employed for the study; such a design of conscious matching of learning style, interactivity mode and the task could have produced more compelling evidence in favor of the nature of a moderating relationship for learning style.

Learner motivation (e.g., expectation that some benefit would accrue from the participation in learning process) is an important prerequisite for effective learning. Where the (desired) outcome is the development of competencies in order to manage familiar problem situations more effectively, learners are likely to use learning modes that exploit their preferred approach to information processing; on the other hand, where the desired benefit is to develop a wider repertoire of learning strategies, they may use methods that do not match their preferred style (Sadler-Smith et al., 2000). Therefore, one other reason for insignificant findings in this study could be that no specific attempt was made to evaluate the nature of learning benefits that subjects expected to obtain from participating in the study, nor was there a specific assessment of their motivation levels (this was assumed to be existent in view of the contest that was instituted, whereby they could win a prize based on their performance). Finally, our instructional program may have been flexible enough for all the subjects, irrespective of their learning styles, to use the system effectively. That is, each student may (prefer to) learn in different ways and yet achieve similar gain in learning. A person's learning preference, therefore, does not preclude or negate what is being learned.

Significant differences between students' attitudes were found between different modes of interaction. Scheffe tests further showed significant differences between high and non-interactive modes, and between low and non-interactive modes. Therefore, overall we conclude that high interactivity mode was the most preferable form of presentation and learning in this study. Learning styles did not have a moderating effect on user attitude. As before, a possible explanation here may be that the nature of the instruction was flexible enough for each subject to experience the learning environment in a way that matched their individual preferences. Additional Pearson Correlation analyses (as before), on each of the three "interactivity mode" subgroups, indicate that "expertise" has significant negative effects on "learner attitude" *in the HIGH interactive mode* ($r = -0.406$, $p < .005$). The correlation coefficients are -0.182 ($p > .10$) for "LOW" and 0.068 ($p > .10$) for NON-interactive mode groups. Yet, the finding that "interactivity" had significant influences on "learner attitude" strengthens our argument that greater interactivity was able to more than neutralize the negative preexisting sentiments the subjects may have had in this study.

Limitations of the Study and Directions for Future Research

Beyond some of the issues brought up in the previous subsection while discussing the implications of the study's findings, one limitation of the research study may very well be that the sample size we actually used for the experiment did not possess adequate "power" to be able to discern the actual *interaction* effects. A larger sample size is necessary to ensure adequate statistical power; however, as outlined earlier, this was beyond the resources for the study. Future research must perhaps plan better on the design of the experiment either by targeting and obtaining a larger size of participation or by other means such as "blocking." Again, due to resource constraints, we could only perform a one-shot study. An important issue for future research would be to investigate the long-term impacts of interactivity on learning. We evaluated achievement and attitude immediately after the experiments. We do not know the long-term effects, if any, from the IMI system and the experiment. For example, one can test student performance after a period of time, perhaps a few days or a few weeks later, to evaluate their absorption/retention of material that was learned at the first exposure. Also, we were not able to capture the material actually reviewed by the subjects in the study who had varying levels of control; such an analysis can provide greater insight into learning behavior.

In terms of user attitude, it is desirable to investigate if the motivation is enduring; this may be reflected by a willingness of students to return to a learning activity without external pressure to do so. It is also perhaps necessary to observe how students change their attitude over time, consequent to being exposed to the type of learning environment used in this study. This can be examined by conducting a longitudinal study, tracing the same group of students over an extended period of time. Finally, despite the care and precautions taken at various stages of design, implementation and beta testing of the prototype systems to translate the learning concepts to design features to system features, it is still possible to make a choice of poor design features or implement poorly good design features. However, the likelihood of this having happened in this study is practically nonexistent.

This study was also limited to learning (and testing) of factual information, although some inferential-type of questions was asked on the tests. As noted earlier, the nature of the task can have an important bearing on the nature of interactivity. The influence of interactivity on achievement may not be identical or similar for different types of tasks/learning (e.g., factual learning, conceptual learning, procedural learning and problem-solving learning). Early television researchers have found visual images to be important aids in procedural tasks (Chu & Schramm, 1967) and problem solving as being more sensitive to the influence of practice (Hannafin & Colamaio, 1987). Future research should study in detail the influence of interactivity on different types of learning tasks.

It may also be desirable to investigate the effectiveness of interactivity for different subject areas or disciplines. For example, history appears to be a very good candidate. Instead of reading a plain text book, video clips of actual places and events can be included in multimedia instruction modules. Hypermedia structure can be used to enhance the instruction by allowing discovery learning, learning of related topics or more detailed descriptions of a particular topic of interest. The underlying philosophy is applicable to business decision-making environments as well; for example, strategic planning demands more exploration and creativity than, say, a routine operational decision. Future research should attempt to extend the questions examined in our study to other disciplines.

Although we provided varying levels of interactivity on *hot spots,* we did not directly capture their use-behavior of these hot spots. It would be desirable to capture their click/use behavior and, thus, analyze the hot spot activity levels to discern (if and) how such activity actually relates to learning performance enhancement and improvement of their attitude. It will also be interesting to examine if this use behavior has any relevance to learning styles; for example, it is reasonable to expect *convergers* and *accommodators* to make greater use of hot spots to facilitate discovery learning. In this study, we made use of Kolb's LSI; however, there are alternative measures of people's cognitive style and, thus, their information processing style. Although conceptually, the same recent research finds that there is little interrelationship among the multiple measures of cognitive style (Leonrad et al., 1999) and that these measure appear to measure different aspects of information processing. It would, therefore, be necessary to identify the more precisely the specific aspect of information processing and learning style that one is interested in and apply the most appropriate measurement of learning/cognitive style.

Research could also be carried out within real-world organizations such as in corporate training. Continuing education of employees offers competitive advantage to organizations; therefore, a field experiment within real-world organizations would be very useful to organizations already using interactive multimedia training to identify if their training programs are effective and whether they need modifications on the pattern of interactivity. There have been estimates, that it costs companies as much as $8,000 - 10,000 per year per person to continuously train/ retool their employees through human-centered traditional programs (Sprague & McNurlin, 1993). Given that companies are under constant pressure to contain costs, they may unfortunately compromise on the quality and depth of training. Computer-based IMI systems are an alternative to save costs and yet provide consistent and effective education/training. For such organizations, a field experiment might suggest if migration to interactive multimedia self-paced instruction would be relevant and how the instructional program should be designed. However, it should be noted that timing of the training should be appropriate within corporations; it should be just-in-time (JIT) so that the knowledge acquired can be put to use by the employees to leverage the beneficial effects and such behavior be reinforced. Such an approach would fit the precepts of *behaviorist* and *cognitivist* theories as well.

ENDNOTES

[1] Max Wertheimer is generally conceded to have advanced the gestalt theory; his book *Productive Thinking* (1959) is perhaps most directly related to the area of learning.

[2] To avoid clutter, we have not represented a situation when the learners are offered no specific choice on frequency or range. Such a *fixed mode* of instructional delivery was labeled "no interactivity" and used as a control group in this study.

[3] Both pre-test and post-test were administered in the same session. Pre-test was administered before the start of the training phase and the actual experimental study, and post-test after the subjects had completed all the tasks involved in the experiment. The subjects were neither aware nor informed that they will be required to take a second test (i.e., post-test). The ordering of the questions for the two tests was different; some of the questions required factual answers while others required evaluative type answers.

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APPENDIX 1

I. NON-Interactive Mode:

This version (used as the control group) let the subjects go through the instruction screen-by-screen (linearly). They had control of the amount of time they wanted to spend on a particular screen; when they were ready to move on to the next screen, they pressed a *Continue* button. In addition, a detailed outline was provided throughout the program to guide the students during the instruction (see Figure A1). Modality of the program was limited to text, image and graphics.

II. LOW-Interactive Mode:

This version of the prototype included some interactive features. For example, learner control capabilities such as the control of instructional *sequence* (i.e., presentation order), *pacing* (i.e., time spent on learning) and *review* or *repeat* instruction were enabled. The range of control was limited to the use of *next* (right arrow) and *previous* (left arrow) buttons, while a *menu* button was also provided

Figure A1: Opening Screen Outline of Non-Interactive Mode Prototype

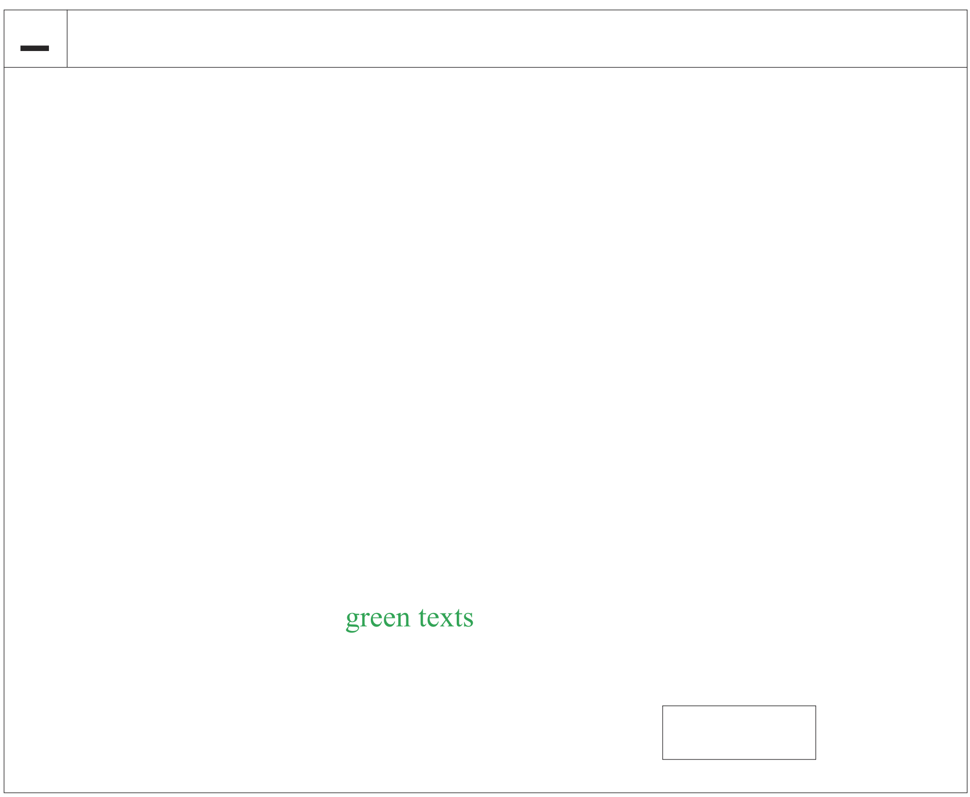

Figure A2: Opening Screen of LOW-Interactivity Mode Prototype — Main Menu

MAIN MENU

SECTION I
INTRODUCTION

Multimedia Definition
Computer Platforms
Multimedia Elements:
- Text & Symbols
- Images & Graphics
- Animation
- Sound
- Video

SECTION II
HARDWARE
COMPONENTS

Overview
Graphics Card
CD-ROM & LaserDisc
Sound Card
Video Card:
- Software-based Compression
- Hardware-based Compression

Texts shown in RED are hotspots, double click the mouse to continue.

for the users to go back to the main menu at any time. The contents were organized in a hierarchy such that the main menu was at the top level where users could select the topics to view (see Figure A2) by clicking on any topic at any time in any order. Certain portions of the texts were shown in red color to indicate that they were “clickable” (hot texts). As a response, students would be presented with the material on a particular topic area they chose. The *menu* button took students to this top-level menu when clicked anytime during the session.

Under each topic on the main menu, an outline of that particular topic would be given in the next level. For example, the menu shown in Figure A3 describes the outline of the *Image & Graphics* topic. Notice that a *previous* screen button is not shown since this is the first screen for this topic. Likewise, a *next* screen button is not available when a subject is at the last screen. The succeeding levels were available as hot texts. They were for the subjects to explore and to be involved in the learning process. A number of hot texts were prepared as examples (using images, sound or video) to help users learn the facts and to help them develop necessary concepts. Under the low-interactivity version, the frequency of hot texts was few, while the modality of the program did not lack any of the multimedia elements.

III. HIGH-Interactive Mode

This version of the prototype included all of the features in the low-interactivity version and several extra features. It was also organized hierarchically, but with a different interface (see Figure A4) where in front of each topic heading, there was a check box which automatically placed an "x" when users went through that particular topic. Once subjects clicked on a topic box, they were presented with the topic content.

In addition, on each screen a line of text at the bottom of the screen indicated how many screens (or slides) were included on that topic and which slide the current one was (see Figure A5) Users could go directly to a particular slide by pressing the slide number instead of clicking the *next* or *previous* button (right and left arrow button). Slide numbers and short descriptions were presented at the top right-hand corner of every screen.

Figure A3: LOW-Interactive Mode — Detailed Outline for Image & Graphics

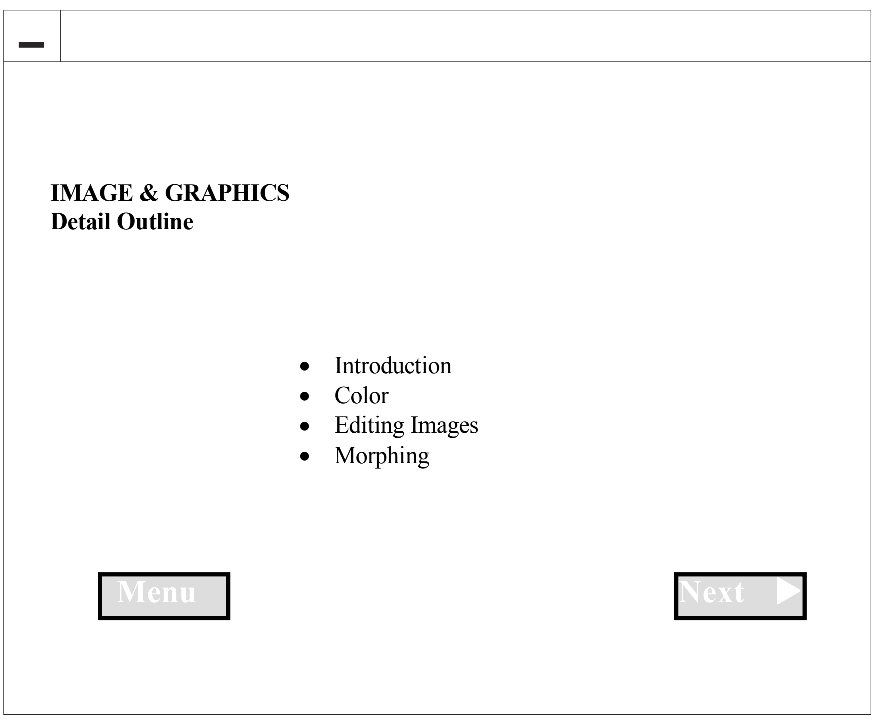

Figure A4: Opening Screen HIGH-Interactivity Mode Prototype

MAIN MENU

SECTION I
Introduction

- Multimedia Definition
- Computer Platforms
- Multimedia Elements:
  - Text & Symbols
  - Images & Graphics
  - Animation
  - Sound
  - Video
- Exercise I

SECTION II
Hardware Components

- Overview
- Graphics Card
- CD-ROM & Laser Disc
- Sound Card
- Video Card:
  - Software-based Compression
  - Hardware-based Compression
- Exercise II
- Index

As an integral part of the instruction program, users got feedback from answering multiple-choice questions which were included at the end of each section (see Figure A6) For all of the available choices, users were given a feedback about their answers whether they were correct or wrong. In case of wrong answers, they were given information about their wrong choices with reason (i.e., identify the errors and suggest "why").

Students had to choose the correct answer before they could continue. The *Menu* button, however, was always available. At the end of the question/answer session, students were provided with their overall performance scores. In addition, there was an index feature where an alphabetical glossary of important terms and concepts were presented (see Figure A7) Users could click on a particular term that they wanted, and they would be provided with the definition or explanation of that term. The purpose of the index was to strengthen learning via verification. In addition to the extra features, this version of the program had high frequency of hot texts and all of the multimedia elements.

Figure A5: HIGH-Interactivity Mode Prototype — A C ontent Screen for Graphics Card

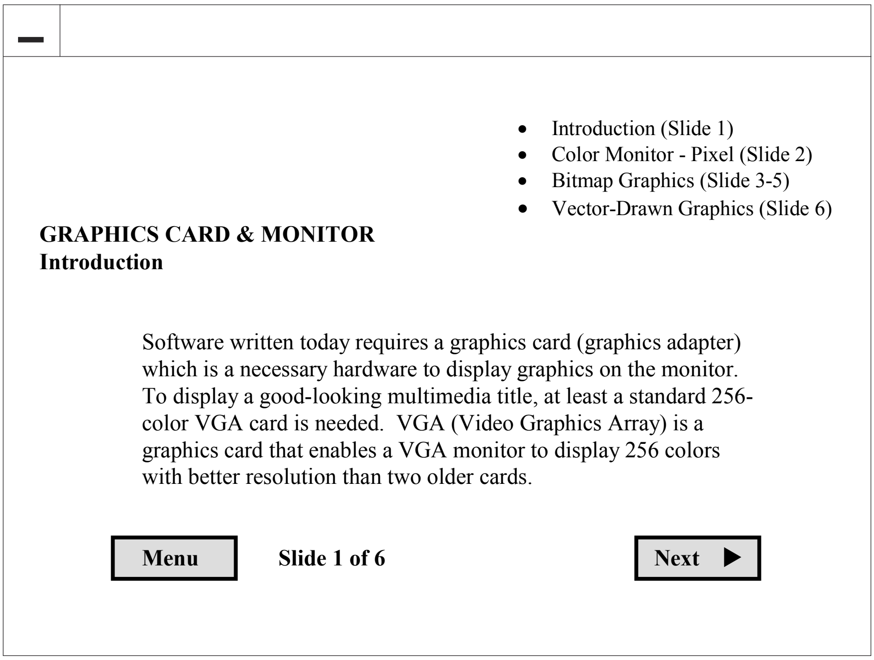

Figure A6: HIGH-Interactivity Mode Prototype — Question & Answer Practice Session

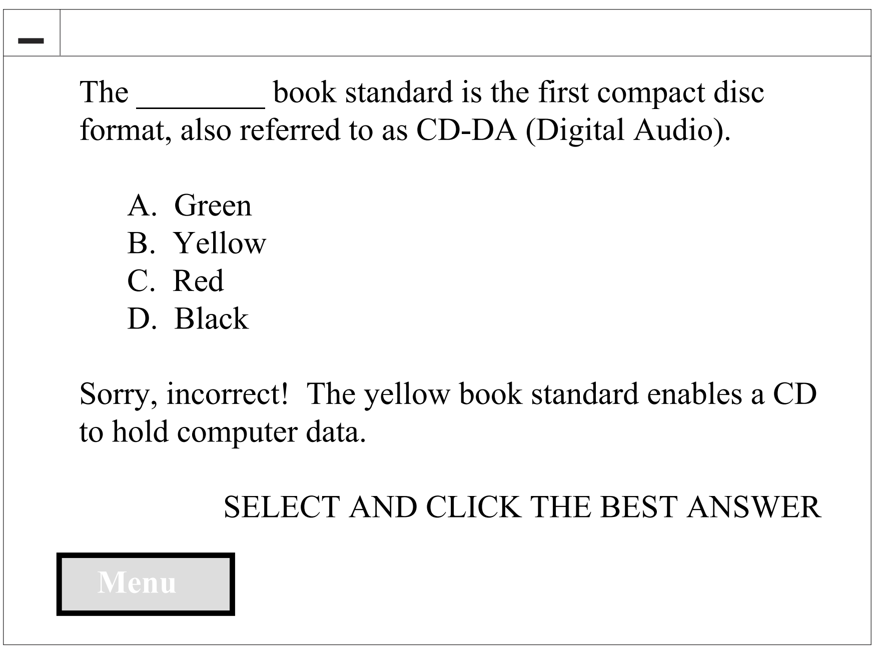

Figure A7: HIGH-Interactivity Mode Prototype — An Index

- AVI
- Bitmap Graphics
- CD-ROM Definition
- CD-ROM Formats
- LaserDisc
- Macintosh
- ~~Morphing~~
- MPC
- Photo-CD
- Pixel
- QuickTime
- Sound Sampling
- Tweening
- Vector-Drawn Graphics
- VGA
- Video
- Video Sampling
- Quit

Morphing is a special effect that can be utilized to manipulate still images or to create interesting animated transformations. It takes two images, and seamlessly changes one image into the other. During the transformation, the second image actually seems to grow out of the first one.

APPENDIX 2

Based on the generally recommended guidelines in the literature (Cohen, 1988; Kirk, 1982), we have made the following assumptions:

- Risk associated with *Type 1* error, $\alpha = 0.05$
- ANOVA being the data analysis and effect size (ES) treated to be medium, $f = 0.25$,
- where

$$f = \sqrt{\eta^2/(1-\eta^2)}$$
$$\eta^2 = \eta^2/(\eta^2 + \eta_m^2)$$

$\sigma^2 =$ variance of each (treatment) set of "k" populations weighted by proportion of its membership size

$\sigma_m^2 =$ variance of the means across the "k" sets of treatment

- Power of the test (rejecting the null hypothesis when it should be rejected; i.e., not making a *Type 2* error), $1 - \beta = 0.80$

- (Numerator) Degrees of freedom of the effects, ***u*** = (I – 1); (J - 1); and (IJ – 1), where
  - I = first effect or main factor being examined (“Interactivity MODE”)
  - J = second effect examined (“Learning Style”)
  - IJ = Interaction effect (of MODE and Learning Style)
- (Desired) Minimum Sample size = ***n***

For the above assumptions on α, β, f and (actual) u (2 for I; 3 for J; 12 for IJ), the minimum sample sizes to provide 80% or more power of detecting the effect and not make a Type 2 error are:

For the three interactivity modes, n = 22; total sample size **N** to be 66
For the four learning styles, n = 23; total sample size **N** to be 92
For the interaction effects, n = 32; total sample size **N** to be 384

Note: As computed above, the minimum total sample size is 66 for the three “interactivity mode” groups, 92 for the four “learning styles” groups and 32 for each of the 12 interaction effects of mode by learning style (total of 384). Clearly, getting such a high participation of about 400 subjects for this study was well beyond the available resources. While this study’s actual sample size of 153 (high = 49; low = 52; no interactivity = 52) appears to meet the size requirements to provide a power of 0.80 in correctly determining the effects of “interactivity,, it falls short of the size required to detect “interaction” effects. It may, however, be noted that the primary objective of this research was to test effects of “interactivity”; examining the moderating/interacting influence of “learning styles” was only a secondary objective.

Chapter XIV

On the Role of Human Mortality in Information System Security: From the Problems of Descriptivism to Non-Descriptive Foundations

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ABSTRACT

The question of whether ethical theories appealing to human morality can serve as a means of protection against information system security breaches has been recognized by several authors. The existing views concerning the role of ethics in information systems security can be divided into two categories. These are (1) expressions about the use of human morality and (2) arguments claiming that the use of ethics is useless or, at best, extremely *restricted. However, the former views are general statements lacking concrete guidance and the latter viewpoint is based on cultural relativism, and can be thus classified as descriptivism. This paper claims that the use of ethical theories and human morality is useful for security, particularly given that Hare's Overriding thesis has validity — though it has its limitations, too. This paper further argues that descriptivism (including the doctrine of cultural relativism) leads to several problems, contradictions and causes detrimental effects to our well-being (and security). Therefore, an alternative approach to using ethics in minimizing security breaches that is based on non-descriptive theories is proposed. The use of non-descriptivism will be demonstrated using Rawls' concept of the "veil of ignorance." The limitations of non-descriptivism, and appealing to human morality in a general sense, will also be discussed. Finally, suggestions for future research directions are outlined.*

INTRODUCTION

The relevance of security solutions and procedures depends on the motivation of the users to comply with the security solutions/procedures provided. Many studies indicate that users fail to comply with information security policies and guidelines (e.g., Goodhue & Straub, 1989; Parker, 1998; Perry, 1985). It is widely argued (e.g., Loch & Carr, 1991; Anderson, 1993; Parker, 1998; Vardi & Wiener, 1996; Neumann, 1999) that a remarkable portion of security breaches are carried out by organizations' own employees. Several proposals have been made to tackle this human problem; the solutions range from (1) increasing the users' motivation (e.g., McLean, 1992; Perry, 1985; Siponen, 2000a; Thomson & von Solms, 1998), (2) using ethics (e.g. , Kowalski, 1990; Leiwo & Heikkuri, 1998a, 1998b), (3) organizational/professional codes of ethics (e.g., Harrington, 1996; Straub & Widom, 1984; Parker, 1998), to (4) using different deterrents (e.g., Straub, 1990). With respect to the second issue — Can human morality function as a means of ensuring information security? The existing works can be divided into two categories. The first category covers expressions concerning the use of human morality including Kowalski (1990), Baskerville (1995), Siponen (2000) and Dhillon & Backhouse (2000):

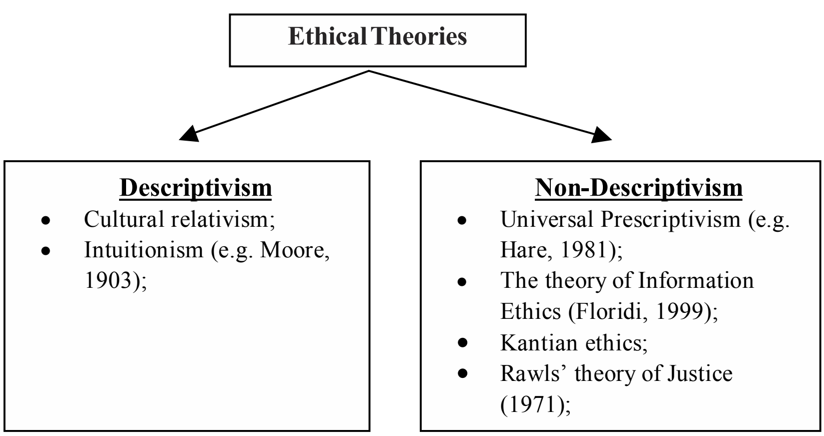
- "*Security administrators are realizing that ethics can function as the common language for all different groups within the computer community*" (Kowalski, 1990).
- "*Proper user conduct can effectively prevent [security] violations*" (Baskerville, 1995, p. 246).

The second claims that the use of ethics is useless or, at best, extremely restricted (Leiwo & Heikkuri, 1998a, 1998b).

This paper argues, following the scholars of the first category, that human morality has a role as a means for ensuring security. But to achieve this goal solid theoretical foundations, on which a concrete guidance can be based, are needed. The existing proposals (e.g., Kowalski, 1990; Baskerville, 1995; Dhillon & Backhouse, 2000) do not suggest any theoretical foundation, nor concrete means for using ethics as a means of ensuring security. The aim of this paper is to propose a framework for the use of ethics in this respect. To achieve this aim, a critique of the relevance of ethics must be considered. The use of human morality as a means of ensuring security has been criticized by Leiwo & Heikkuri (1998a,b) on the grounds of cultural relativism (and hacker ethics/hacking culture). If cultural relativism is valid as an ethical doctrine, the use of human morality as a means of protection is very questionable. It would only be possible in certain "security" cultures—i.e., cultures in which security norms have been established—if at all. However, the objection of Leiwo & Heikkuri (1998a,b) is argued to be questionable. We feel that cultural relativism has detrimental effects on our well-being and security. Things might be better if the weaknesses of cultural relativism were recognized. This paper adopts the conceptual analysis in terms of Järvinen (1997; 2000) as the research approach. An early version of this paper was presented at an international conference on information security (IFIP TC11, Beijing, China, 2000).

The paper is organized as follows. In the second section, the possible ethical theoretical frameworks are discussed. In the third section, the objections to the use of ethics as a means of protection based on cultural relativism (descriptivism) are

Figure 1: Depicts the Division and Some Ethical Theories



explored. In the fourth section, an alternative approach based on non-descriptivism is suggested. The fifth section discusses the implications and limitations of this study. The sixth section summarizes the key issues of the paper including future research questions.

THEORETICAL FRAMEWORKS

Ethical Theories

The philosophical ethical theories can be classified into two categories, descriptivism and non-descriptivism (Hare, 1997). In this paper, descriptive theories refer to ethical doctrines that attempt to draw a morally or action-guiding conclusion purely from a set of factual premises, such as prevailing cultural habits. In other words, the separation between descriptivism and non-descriptivism can be retraced to Hume's thesis that moral norms (what we ought to do) cannot be drawn from a set of factual matters. Those theories arguing that factual matters imply moral norms, are called as descriptivism, as opposed to non-descriptivism. This simplistic division is chosen for a practical reason; it is perhaps the simplest classification and therefore helps us to understand the different theoretical possibilities available and their one fundamental difference.

We have left out religion-based ethical theories (e.g., Christian ethics) from the categorization. The reader is advised to look at Outga (1972) for more religion based ethical theories and the question of descriptivism versus non-descriptivism ("is/ought"-problem). We believe Siponen (2001); Siponen and Vartiainen (2001), as many others have already proposed (e.g., Hare, 1981, 1997; Taylor, 1975), that descriptive theories such as cultural relativism and intuitionism are inadmissible as moral qualifiers. Instead of attempting to find what is morally right and wrong, descriptive theories, at best pay lip service to prevailing cultural moral notions (cultural relativism) or individual's intuitions (intuitionism). In the worst possible scenario, descriptive theories may be used as an excuse to indulge in morally questionable behavior (e.g., Nazism or hacking), as shall be seen in section three. In Section four, it is proposed that we should look to non-descriptivism to provide solutions. In this study, the term moral means what people regard as right and wrong – how we should act in the final analysis. Ethics refers to moral philosophy, i.e., ethical theories discerning what is morally right and wrong.

Overriding Thesis

In order for human morality to be useful in security procedures, it is necessary that we should have an intrinsic sense of moral responsibility, in other words, a sense of duty forcing us to follow our moral concerns: to find out what is morally right. If all people were totally amoral (i.e., did not care what is morally right) or if theories such as cultural relativism were considered as valid moral qualifiers (as proposed by Leiwo & Heikkuri, 1998a; 1998b), human morality could not function as a means of ensuring security. We need to examine whether there is such a thing as "moral responsibility"? And, if there is, how strongly does it guide our behavior? These two questions (and the relevance of human morality for security) can be retraced to the validity of the overriding thesis suggested by R.M. Hare (1963). Hare claims that moral concern overrides all other nonmoral concerns (overriding thesis). In other words, given that one regards unauthorized copying of software as morally wrong (moral concern), one should not copy software even if one would receive financial gain (nonmoral concern). Ladd (1982, 1989) has suggested a similar view: our moral responsibility (what is morally right) overrides other forms of responsibilities. Smith (1984) even argues that it is more understandable to act for moral reasons than for nonmoral ones. This latter view has been criticized by Dancy (1994), on the grounds that moral, or justified, reasons do not imply motivation *per se* (Dancy argues that one may see nonmoral reasons as understandable as well). If Hare's overriding thesis is valid, appealing to human morality is crucial for ensuring security.

ANALYSIS OF THE EXISTING DESCRIPTIVE APPROACH AND ITS WEAKNESSES

Theoretical Underpinnings

Leiwo and Heikkuri (1998a, 1998b) argue that human morality cannot serve as a means of protection against security violations — particularly in a global environment (e.g., the Internet) — because of cultural relativism. They argue that moral values are subjective in the sense that they cannot be transferred from one place or moral system to another (Leiwo & Heikkuri, 1998b, p. 275). In other words, the morality of an action depends on culture: what is morally right in one culture may be morally wrong in another culture. This argument also involves ethical descriptivism, since they indicate that moral judgement has a truth value (e.g., true/false): "*the truth values of ethical value systems…*" (Leiwo & Heikkuri, 1998b, p. 275).

Leiwo and Heikkuri further engage in cognitivism, which is mainly an epistemological claim stating that values can be known to be true. In the case of cultural relativism, exploring the moral values of cultures is argued to validate this cognitivistic claim (values can be known to be true). Because it is regarded as a sociological fact that morality (what people do/consider as right and wrong) depends on culture, relativists claim that what every culture does is equally right or true. The reasoning of Leiwo & Heikkuri is similar to this. They argue that cultural relativism is valid and moral views differ with respect to information security. The culture of hackers and hacker ethics was provided as a proof (Leiwo & Heikkuri, 1998b, p. 275). Since "hacker ethics" by hacker "Knightmare" (see more Fiery, 1994) and cultural relativism were provided by Leiwo & Heikkuri as an example to indicate the inadequacy of human morality as a means of ensuring security, we next examine these concepts in more detail.

Weaknesses of the Descriptive Approach

Is-Ought Dualism

The approach of Leiwo & Heikkuri does not take into account the factual/normative dualism first recognized by David Hume. This dualism is also known as Hume's law or the thesis "no ought from an is". We share Popper's view that Hume's law is "*perhaps the simplest and most important point in ethics*" (Popper, 1948). "No ought from is" means that factual premises alone, i.e. 'is' cannot imply norms, i.e. 'ought' statements. So, for example, what people/culture regard as morally right ("is") does not provide the answer to what one morally ought to do ("ought"). Leiwo & Heikkuri (1998a, 1998b) fall into this ("is" implies "ought") fallacy by first observing "is" matters: hacker ethics/culture. From this they deduce that, due to relativism (what every culture does is right), the actions of hackers (or hacker ethics) are right per se, therefore they are implying an ought from an is.

Although there are attempts to prove the invalidity of Hume's thesis "no ought from an is" including Searle (1964), Gewirth (1974) and MacIntyre (1981), they do not serve as persuasive objections especially when addressing cultural relativism. For example, Searle's attempt to break Hume's law is widely criticized as being a game which can only be played if the players accept the rules of the game provided by Searle (Hare, 1964a). It may serve as an indication that it is possible to persuade someone to form an "ought" (or moral) judgment by giving "is" matters without "ought" matters. But does this prove that this kind of treatment would be desirable? The most difficult problem with Searle's argument is that "the rules of the game" are based on persuasion, and the rules do not provide any restrictions regarding the contents of the strategy agreed upon, which means that the game is, for instance, open to lying. The main objection to this is, if lying is acceptable, we are throwing ethics and morals out of the window. Gewirth's idea (of equality) is closely connected to the universality thesis, which serves as a basis for his ethical theory/socio-political theory (e.g., see Gewirth, 1978), and therefore, even if accepted, does not help cultural relativists. Moreover, Kohlberg's thesis is the opposite of cultural relativism as it accentuates Kantian universality thesis ("act only on maxims which you want to be universal laws") as the highest state of moral development.

Is-Ought Dualism and a Practical Example

The weakness behind the thesis of Leiwo and Heikkuri (1998a, 1998b) can also be considered by using a more down-to-earth example. An employee is working in a company involved in a top-secret project. The employee joins an association that has its own moral code and the company accepts their employee's joining this association because the company considers the activities of the association are harmless. Later, the members of the association start to take an interest in philosophy and finds out that their background has been forgotten and is rather different to the one they assumed was correct. They are advocates of cultural relativism and so they perform a "who are we really/what are our moral values" perusal (e.g., provided by Sandel, 1982). This is a way to reflect "is" matters, i.e., how things were/are, and to allow this to determine how things should ultimately be. As a result of this, they find a new moral code that better reflects their original background and they are positive that this is their real moral code. This new code allows hacking, the result being that the employee is now encouraged to break into his company's system (or otherwise allow the association access to top secret information). If the company and the employee acknowledge cultural relativism as a valid moral qualifier, they have no (moral) right to either prevent such actions or take any stand with respect to these actions, otherwise they have interfered with the other culture[1] . Thus, as mentioned, any (moral) involvement with the other culture is not acceptable according to cultural relativism. The company in our example therefore cannot take any moral stand concerning some other culture (the association in our example). This is not a very convincing justification.

Hacker Ethics and Cultural Relativism

Knightmare states "*hacking is something that I am going to do regardless of how I feel about its morality*" (Fiery, 1994, p. 162). It is difficult to see how such a view can have connections to the domain of moral discourse (or real hacker ethics). However, such evasions of moral reflection can be justified given that cultural relativism is regarded as a valid moral qualifier. Knightmare could insist that hackers form a culture and due to cultural relativism, we should allow them to do whatever they do. This illustrates another weakness of culture relativism (and hacker ethics, as well). Cultural relativism and Knightmare's version of hacker ethics do not truly attempt to discover what is morally right and wrong. Rather they avoid moral scrutiny and uphold dogmatism.

Hegel: Cultural Relativism and Hacker Ethics

Leiwo & Heikkuri (1998a, 1998b) also validate cultural relativism and hacker ethics on the basis of Hegel. This totally relativistic view is not shared by Hegel[2] . Hegel recognizes the problems associated with cultural relativism. Cultural relativism holds that all beliefs/belief systems are equally true. Hegel does not share this view. Hegel sees that moral conflicts should be solved in such a way that one's freedom and above all the coherence of the state (i.e., government/country) are ensured (Sabine, 1963, p. 655). Hence, if one follows Hegel's doctrine when considering if it is acceptable to allow hacking, one needs to ponder which alternative ensures the coherence of the state. Note that hacker ethics contain the rule "*mistrust authority — promote decentralization*" (Fiery, 1994). This implies that governments should be mistrusted. Therefore, hacker ethics are in conflict with Hegel's doctrine. Hacker ethics also state "*all information should be free.*" To let all information be free does not maintain the coherence of state (government), and is therefore wrong from the Hegelian viewpoint. Hence, Hegel's moral theory does not allow hacking in a general sense.

Self-Refutation

The theory of cultural relativism involves a contradiction (explicitly the *reduction ad absurdum*). It does not make any logical sense to claim that all moral judgements are relative, while maintaining that moral relativism itself is absolutely true (being non-relative). If all moral beliefs are relative, as relativists claim, absolutely true theories are an impossibility (Hare, 1986; Niiniluoto, 1990). This would also apply to cultural relativism[3] .

NON-DESCRIPTIVE USE OF ETHICS

The central task of moral philosophy is to determine what kinds of actions are right or wrong (Warburton, 1996; Hare, 1981). Descriptivistic theories such as cultural relativism fail to accomplish this mission: for example, cultural relativism does not explore what is morally right or wrong, but rather emphasizes what the moral habits of cultures are. It is argued that non-descriptivism offers more solid ground. Non-descriptive theories trying to discern what is truly morally right, what we ought to do, instead of appealing to our intuitions or cultural conceptions.

We see that many information security activities have strong moral dimensions. Information security protects against actions such as hacking or computer viruses, which may raise serious moral concerns. People who are victims of such activities (e.g., hacking or destructive viruses) are likely to express strong moral disapproval of the people responsible for such activities. However, without such personal experiences, critical moral thinking or ethical education, etc., some users might feel neutral about such activities. In fact, computer ethics literature agrees that the ordinary computer user is often incapable of extending their moral reflection in cases where computers are involved. Several reasons to explain this problem are proposed. Moor (1985) explains this phenomena by the conceptual muddle and policy vacuum, i.e., the existing policies, such as legislation, do not cover computer ethics issues. Conger et al. (1994) and Rubin (1994) argue that there is moral distance. For example, the Internet creates a distance between users, and this distance decreases our moral sensitivity. Severson (1997) believes that people are in moral crisis. Siponen (2001) and Siponen & Vartiainen (2001) postulated that such users are conventionalists, i.e., they are pretty much incapable of engaging in critical moral thinking, but their acts reflect the prevailing moral views. As computer ethics issues are new, and the existing prevailing moral conventions do not yet cover computing issues, conventionalists are unable to react to computer ethics issues. According to Dunlop & Kling (1992) and Rogerson (1996), computer users are under the spell of computers forgetting the negative consequences of their usage. One may also argue, on the basis of Floridi (1999) and Gorniak (1996), that the existing ethical theories are inadequate to address computer ethics issues.

It is believed that some of these problems — such as moral crisis (Severson, 1997), moral distance (Rubin, 1994), conventional moral notions (Siponen, 2001; Siponen & Vartiainen, 2001) and the "spell" of computers (Dunlop & Kling, 1992, Rogerson, 1996) may be tackled with proper education. This effort may help in securing an organization's information systems, as well. However, in order that appealing to human morality would be useful for information security, the following conditions need to be met. An organization's business activities must be able to stand up to moral scrutiny and the organization's activities must not include double standards of morality. If the employees of the organization regard the organizations' activities as improper, it is unlikely that they will respond to educational efforts. Organizations must display proper (moral) respect for their employees. If employers disrespect their employees, employees may have a reserved or negative attitude concerning such educational efforts. Organizations should facilitate an open climate for communication. Open environments for discourse as described by Habermas (1984, 1987) should be created. The immorality of acting against security policy can, with the help of ethical theories, be effectively argued. If an organization's employees are convinced that it is morally praiseworthy to follow the organizations security policy/procedures, they may be more willing to follow the policies/guidelines (consider the overriding thesis in section two). Equally, if an employer/educator is able to awaken employees' moral disapproval regarding acting against security policies/guidelines, it may be presumed that the employees will be more willing to follow security policies/guidelines (again consider the overriding thesis in section two).

In addition to the aforementioned prerequisites for using ethical education in organizations, the following guidelines for using ethics to persuade the listener can be used:

- Justify the principles (e.g., ' veil of ignorance'/universality thesis as described below): state that the chosen principle is the best possible for the situation.
- Apply this principle and justify the results (justify the claim that the situation is morally acceptable and favorable).

These principles also facilitate the requirements of free will and autonomy. In other words, the problem of indoctrination might be avoided if the reasons for choosing certain ethical theories are justified. Indoctrination should be avoided since it halts autonomy — free will and autonomy are prerequisites for ethical decision making (cf. Hare, 1964b, 1975).

Example of the Use of the Veil of Ignorance

Let us consider whether hacking is allowed, i.e., whether is it morally acceptable to obtain unauthorized access to information systems. This action is considered in the light of a simplified version of Rawls' theory of justice, which is affiliated with the universality principle proposed by Confucias (Singer, 1991), Kant, Hare (1963; 1981), Christian ethics (the Golden Rule) and Gewirth (1978). The limitations of the 'veil of ignorance' are discussed in Kukathas & Pettit (1990; Pogge, 1989). The limits of universality theses are discussed generally in Siponen (2001; Siponen & Vartianen, 2001) and Hare's version of universalizability of moral judgement in Seanor & Fotion (1988).

Rawls (1971) proposes that the principles of justice — herein: should we allow hacking or not — should be selected under an imagined ignorance of our own role in the world (called a 'veil of ignorance'). Under the veil of ignorance we are ignorant of our status, age, gender and the like. In doing this, the veil of ignorance strives to achieve impartiality since we are choosing principles that are equal for all, irrespective of our differences in terms of age, status, gender, color of skin, cultural background — and systems, etc. This action prevents us from tailoring our moral principles to suit our role and disregarding the principles of the occupants of other roles (Hare, 1981, 1986; Rawls, 1972). Furthermore, the mentioned qualifiers (e.g., age, sex, reference to particular information systems) are ruled out since they are likely to be morally irrelevant to the choice of principles of justice (Rawls, 1972; Hare, 1963, 1981, 1989; Siponen, 2001). It just does not make any sense to claim that e.g., gender or ethnical background is relevant to the question of who is allowed to break into information systems.

So, in the case of hacking, given that the application of the veil of ignorance is desired, we need to imagine a situation in which we are unaware of our social status, age, sex, profession, etc. From behind this veil of ignorance we would need to ask ourselves whether we accept that hacking is allowed for *everyone*—i.e., anyone can break into any information systems at any time. This means that if we engage in hacking, we have to allow everyone else the same "right," even at the risk of them breaking into our systems. We submit that most of us, under the veil of ignorance, would not find hacking acceptable in a general sense. The reason being that if hacking is morally acceptable, there are no such things as company business secrets and individuals' privacy. Therefore 'private' information such as medical information, social security numbers and financial information would be freely available for all to inspect. The result of which is most people feel more comfortable living in a society where hacking is not acceptable.

DISCUSSION, LIMITATIONS OF THE STUDY AND FUTURE RESEARCH QUESTIONS

The existing views on the relevance of ethics and human morality as a means of protection can be divided into two categories. First ethics and human morality can be used as a means of ensuring security and, second, the use of ethics is, at best, highly restricted, if not impossible. The underlying theories and justification for the two views differ. Proponents of the first view have not offered any theoretical background to justify their claims. In turn, the second view (the use of ethics is restricted to certain "security cultures") is based on cultural relativism (and hacker ethics) and can be classified as descriptivism. This paper explored the theoretical foundations of using human morality, criticized the descriptive view and proposed a non-descriptive approach for using human morality as a means of protection. Conceptual analysis was chosen as the research approach. This is a relevant choice since there is a lack of a solid ethical framework in current literature, and there is a need for a critical analysis of the existing descriptive view. Therefore, firm conceptual foundations are needed as a first step, and conceptual analysis is the proper way to build such foundations.

Implications for Research and Practice

As for researchers and practitioners, this paper has clarified the point that human morality has a role in terms of security within organizations. This study also demonstrated that the argument against the relevance of human morality as means of protection, on the basis of cultural relativism and hacker ethics, was fallacious. The study also clarified the limits of human morality (see limits of the findings). Furthermore this study has suggested several future research questions (see below). Moreover, with regard to practitioners, this paper has offered practical guidance on how ethics can be used as a means of ensuring security. It should be noted that the use of human morality at the fullest extent calls for educational skills and knowledge on moral philosophy. The application of ethical theories at an organizational level is not an impossibility. The question and challenge is where the educational and research/development efforts at universities and in organizations should be invested. Is an organization's security only a technical matter? Or has it strong social dimension, as is increasingly recognized by scholars?

Limitations of the Findings

The use of ethics as a means of ensuring security has a few limitations, however. First and foremost, it should be noted that the use of ethics is not a panacea. There is evil in the world (e.g., Warburton, 1996). This means that there are likely to be people who want to behave egoistically or maliciously, regardless of the moral status of such behavior. Secondly, human morality can be used as a means of indoctrination. This may have short-term positive consequences from an organizational viewpoint. However this may turn against the organization in the long run. Moreover, intentional indoctrination is not morally acceptable since employee autonomy and free will are violated. Thirdly, moral philosophy would be useful for security only when an organization's security or business actions can withstand moral scrutiny. An organization's security or business activities are not per se morally right. For example, organizations may use information hiding (steganography) to carry out morally questionable activities. Fourthly, the use of ethics requires knowledge of ethical theories and persuasive discussion skills. Fifthly, without skillful education, the problem of indoctrination may come into play: a charismatic educator may ignorantly indoctrinate the employees. Sixthly, even if we want to behave morally right the fact remains that our decisions are deemed to be subjective. For example, it is possible, at least in theory, that after an application of the same ethical theory (e.g., the universality thesis) people would end up with differing views (philosophers are debating whether this is the case or not, see e.g., Seanor & Fotion, 1988; Hare, 1999). The likelihood of the fourth problem may increase when we want to respect autonomy in moral matters, i.e. avoid indoctrination. Finally, we hold with R.M Hare that "*nobody can hope to write the last word on a philosophical subject; the most he can do is to advance the discussion of it by making at least some things clearer*" (Hare, 1981).

Future Research Questions

There are a few research questions that future research should address. First, given that practitioners could use human morality as a means of ensuring security, studies that show how different ethical theories (non-descriptive) can be used for this purpose should be conducted. Secondly, empirical investigations are needed to explore whether computer users perceive morality as overriding over other nonmoral (such as financial) concerns (cf. Hare's overriding thesis in section two). Finally, further studies are needed to investigate what are effective persuasion strategies in ethical discussion (whilst at the same time avoiding indoctrination) and what are their effects. The possible research approaches would be conceptual analysis and empirical (theory testing/theory creating) research.

CONCLUSIONS

There is no doubt that the user has a significant role to play in building information security in organizations. Therefore, it is no wonder that the relevance of ethics as a means of ensuring security has been debated in information security literature. However, the current literature lacks solid theoretical foundations. Firm foundations are important to justify whether human morality has a role as a means of protection. It is necessary to examine the question of applicability and how to appeal to human morality as a means of protection. To build this foundation, we look to the wisdom of ethical theories. To increase our understanding of the fundamental differences between ethical theories, the theories were classified into two categories, descriptivism and non-descriptivism. It was shown that the question of whether ethics and human morality have any relevance can be retraced to Hare's overriding thesis (moral overrides all other concerns). The descriptive claim that ethics cannot serve as a means of ensuring security, based on cultural relativism, was considered. It was shown that this descriptive view — that ethics is of little use in securing organizations — encompasses several problems. To avoid these problems, an alternative non-descriptive approach was proposed and an example of its use was given. Four prerequisites and a two-step persuasion guideline for using ethics as a means of ensuring security were put forth. Moreover, limits of the use of human morality were considered. Finally, several future research questions were suggested.

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ENDNOTES

1 One may raise an objection towards my use of the word 'culture' by stating that an association, in this example, is not a culture, but it exists within a culture. If tribes or hackers are considered to be 'cultures' then associations should be accorded the same treatment. At any rate, further considerations concerning whether an association is a culture or not are irrelevant for this example. The example given can be safely modified so that the association is not a culture, but is within a culture, and the values of this culture are exactly the values of the association (and the company is outside of this culture).

2 Hegel can perhaps be seen to be a kind of "relativist" as, in his view, we must recognize the fact that we all have a history. Because of this, Hegel believes that we cannot share the same categorical imperatives, as put forth by Kant, for instance. This may violate Hume's law provided that the different histories are regarded as "is" matters from which an "ought" conclusion is inferred.

3 Similar reduction *ad absurdum* fallacies, with respect to cultural relativism, have been formulated. Hare (1986), for example, has pointed out another such fallacy, he claims that the existence of such fallacies raises objections to all descriptive views, given that they lead to cultural relativism. The association example provided earlier illustrates another contradiction. The association accepts hacking while the company does not, and the "culture" of the company is just a short distance away from the "culture" of the association. Hence, there seems to be a contradiction in saying that the exact same action in all respects (e.g., hacking) is acceptable (by the association) and not acceptable (by the company). This idea also conflicts with the supervenience relation, e.g., (see Hare, 1952, 1984; Kim, 1984, 1991), as it is inconsistent to claim that the same action can be simultaneously both wrong and right, depending on the culture.

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Chapter XV

Chaos Theory as a Framework for Studying Information Systems

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ABSTRACT

This paper introduces Chaos Theory as a means of studying information systems. It argues that Chaos Theory, combined with new techniques for discovering patterns in complex quantitative and qualitative evidence, offers a potentially more substantive approach to understand the nature of information systems in a variety of contexts. The paper introduces Chaos Theory concepts by way of an illustrative research design.

INTRODUCTION

The past decade or so has witnessed considerable discussion around the study of information systems (IS). There have been a number of initiatives that have attempted to introduce theories and frameworks that might inform our understanding and research in IS (e.g., see Giddens, 1984; Nissen, Klein, & Hirschheim, 1991). Most of these initiatives have come from those who have been dissatisfied with the narrow technical conceptions of IS research. There have been repeated calls to address the social and organizational issues with respect to IS (e.g., see the collection of papers by Boland & Hirschheim, 1987). It has been argued that although the discipline has sought to address the social and organizational issues, there has been a shortage of well grounded theory and methodology on how to address these aspects (see Walsham & Han, 1990). Although in recent years there have been some attempts to fill this gap, we have as yet not been able to identify an appropriate theoretical basis for the study of information systems.

This paper introduces Chaos Theory as a means of studying IS. The paper uses the concepts to reflect on the nature and significance of IS. It is hoped that understanding the underlying assumptions and theoretical constructs through the use of Chaos Theory will not only inform better research design for studying information systems but also help practice in understanding the intricate relationships between different factors.

The paper is organized into five sections. It begins with a description of the research problem and the approach. It then sketches out the manner in which Chaos Theory views information systems. Implications for research and practice are presented in the fourth section. Finally key messages in the paper are identified and broad conclusions drawn.

THE RESEARCH PROBLEM AND APPROACH

The Problem

It has been argued that an assessment of a particular discipline must proceed with an implicit or explicit understanding of what the discipline is and how it develops (see for example Banville & Landry, 1989). In the domain of IS, there is a problem both with the manner in which we have studied IS and also with the theoretical basis that has been adopted for their study. More often than not, IS researchers have been involved in 'academic demolition'[1] . This has resulted in an inadequate analysis of the basic premise on which a theory is based.

One of the more exciting developments in studying IS in recent years has been the use of Structuration Theory (Giddens, 1984). It is the seminal work of Walsham (1993), that has brought the Structuration Theory concepts within easy reach of IS researchers. Walsham uses Structuration Theory to augment the richness afforded by contextualist analysis of managerial situations. Earlier researchers (e.g., Madon, 1991) have shown that the contextualist approach of Pettigrew (1985) falls short on a number of counts. The foremost limitation of Pettigrew's approach is the lack of emphasis on the connection between what he terms the outer context and the other contextual levels. Although the use of Structuration Theory and the notion of Agency in IS research has been advocated by Walsham, it could be argued that the work tends to focus primarily on the internal organizational politics and procedures. In that respect Structuration Theory has been applied to IS in a similar way to its use by other management theorists (Ranson, Hinings, & Greenwood, 1980). Indeed there is little analysis of the changing markets and government regulations, of managerial legitimacy which may consider issues of 'gentlemanly' conduct, 'scientific' approaches that may legitimize key perspectives, norms and procedures and friendship (see Giddens, 1973, p. 171). A fuller discussion of the manner in which Structuration Theory can been used in IS research appears in Kawalek (1997).

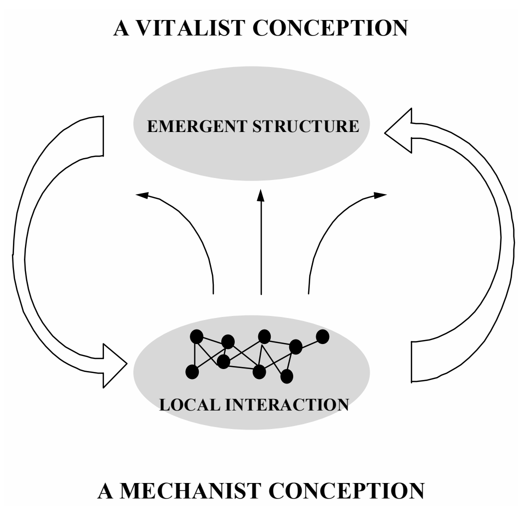
It is beyond the scope of this paper to present a comprehensive review of the dominant theories that have been proposed for studying IS. The brief critique of Structuration Theory, was to illustrate the problems inherent in the study of IS. The inability of theory to afford a comprehensive analysis does not necessarily suggest the limitation of the concept itself. As Walsham himself writes: "theory is both a way of seeing and a way of not seeing" (Walsham, 1993, p. 6). Therefore what we need are theoretical concepts that help us to view problem situations from a multi-faceted perspective. Clearly most theories used in current IS research seem to address a particular kind of a problem. In many cases the original intention of the researchers was to use one theory as a means to analyze particular issues. But we cannot assume that all problems related with IS can be handled by one particular theoretical concept. It will be argued below that the nature of IS and their role within organizations affords them being studied at multiple levels. In conducting this argument we propose that Chaos Theory affords a meta-theoretical conceptual basis on which to carry out such studies. Before developing this argument further, we present two viewpoints that have been prevalent in studying IS.

Conceptions in IS Research

The purpose of this section is to highlight the extent to which the current approaches for studying IS have either a "Mechanist" or a "Vitalist" conception (Checkland, 1981). The term *Mechanist* is used to summarize the rational constructs used by many researchers in studying IS, in the context of other business topics, taking the stance of 'information technology applied to business' (Stacey, 1991). *Vitalist* is used to summarize those approaches to studying IS that start from the subjective viewpoints of the human actors involved, without any contextual constructs or assumptions. Although many approaches cannot strictly be confined to either of the two poles, a discussion on the ontological and epistemological beliefs will help us in critiquing orientation towards a particular dominant paradigmatic thought. The demarcation between Mechanist and Vitalist perspectives is based on the way in which the functioning of organizations is considered. If the presumption is that all change is *within a given* social structure, it is Mechanist in nature. If we presume that all change is *a result of* a changing social structure, then we would consider it to be Vitalist in nature. While Mechanists have a unidirectional vision, Vitalists dwell on the assumption that some unknown or invisible property (or properties) determines the behavior of entities in the system. Hence they are opposed to the manner in which Mechanists look at local interactions within an organization to postulate the emergence of some global property (see Figure 1).

Mechanists and Physicists seem to have similar ontological roots. Hence they view reality to be independent of and external to human consciousness. Such a viewpoint has consequences to the manner is which IS are generally conceived. More often than not, Mechanists would consider IS to be socio-technical artifacts. Because of the intrinsic belief of Mechanists in the immutable laws of causality, they seem to consider IS in terms of intricate interactions and relationships. Hence they lay a lot of effort in predicting the outcomes when technology based systems are put in place. In terms of studying IS, researchers with a dominant Mechanist conception often have an over-reliance on traditional mathematics and logical tools to analyze and predict social phenomena, often to the limits of absurdity. Mechanists use mechanical or biological models to understand organizations, hence many of the

Figure 1: Mechanist Versus Vitalist Conceptions in Studying IS (Adapted From Lewin, 1993)



socio-political aspects affecting IS, such as resistance to change, are considered consequences of ignorance at best and dysfunctional behavior at worst.

The Vitalists on the other hand consider IS as social constructions that derive from the intersubjective experiences of human actors. Therefore they find coherence in the shared meanings of the organization. Vitalists make no claim to any form of objective knowledge. In fact given the complexity and idiosyncrasy of human experience, the Vitalist metaphysics implies that there are no universal laws of causation in the social world waiting to be discovered and harnessed through the scientific method. This is more so the case with respect of IS. The Vitalists therefore propose that one should use their intellectual abilities to interpret the socially constructed subjectivity associated with information systems rather than manipulating the synthetic causal laws of success. As opposed to the Mechanists, Vitalists do not see organizations as coherent structures with an agreed set of goals. Rather, they see organizations as a conglomerate of various interest groups that pursue a suite of goals that may not necessarily be in resonance with one another or with the organization at large. IS therefore are considered as fulfilling intentions of different interest groups, rather than the corporate good.

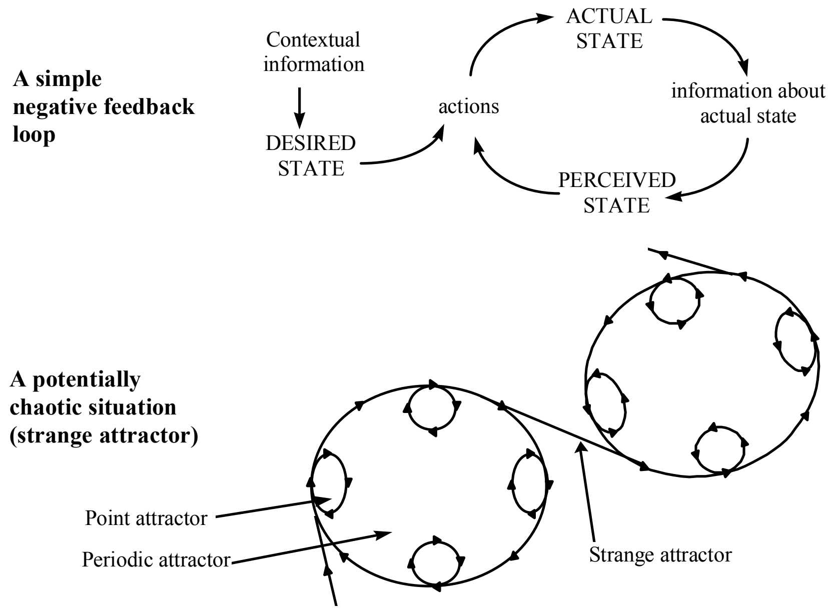
Chaos Theory as an Approach

Traditionally IS researchers are divided in terms of having a dominant Mechanist or a Vitalist stance. A Chaos Theoretic perspective attempts to bring together the Mechanist and Vitalist conceptions. In that sense Chaos Theory itself represents the beginning of a new science. As Peters (1991) suggests: "Chaos breaks across the lines that separate scientific disciplines. Because it is a science of the global nature of systems, it has brought together thinkers from fields that had been widely separated" (p. 5).

The origins of Chaos Theory can be traced to the work of Kovalevskaya in 1889 when she proposed the mathematical definition of dynamic instability (see DeGrauwe, Dewatcher, & Embrects, 1993). This work was later enhanced by Poincaré in the late 19th century to study planetary motion. In the 1920s two French mathematicians, Julia and Fatou, used the original concepts to study unusual geometric shapes. In the 1970s this led Mandelbrot to generate chaotic fractals. These were then applied to analyze seemingly random, historical cotton prices. The analysis provided clear evidence that it was possible to identify similar patterns of changes in prices in different periods of time. More recently Chaos Theory has been used to examine the behavior of stock and bond markets (Radzicki, 1990) and exchange rates (DeGrauwe et al., 1993).

So what is Chaos Theory? It refers to an emerging scientific discipline[2] which focuses on the study of non-linear dynamic systems (e.g., see Gleick, 1987). A non-linear dynamic system is one where any relationship between time-dependent

Figure 2: Nature of a Chaotic System (In Part Incorporated From Radzicki, 1990)



variables is non-linear. Non-linear dynamic systems can be defined in terms of their equilibrium state. This is because any dynamic system is expected to be in a particular state of equilibrium at a given time. Comprehending the nature of the equilibrium state helps in identifying the hidden order in apparent chaos. These systems have three types of equilibrium: stability, explosive instability and chaotic equilibrium (e.g., see Ruelle, 1988 and Figure 2).

A system is said to achieve *stability* when it is controlled by a negative feedback. In such a situation, after experiencing all the changes, a system achieves a new equilibrium position. In understanding the nature of a stable system, distinction needs to be made between the actual state of the system and the desired outcome. Any discrepancy between the two states motivates action. Such actions result in bringing the actual state in harmony with the desired state. If corrective action is delayed, the system will begin to fluctuate. This type of behavior is experienced quite frequently in organizations (e.g., a factory needs time to produce widgets before replenishing stock) (e.g. see Stacey, 1991; Radzicki, 1990).

A system achieves *explosive instability* when it is driven by a positive feedback. A positive feedback reinforces the initial change made in any of the variables. Such small changes accumulate exponentially over a period of time and may result in an explosive situation. Situations representing explosive instability often render forecasting impossible.

A system is said to be in a chaotic state when there is the simultaneous and unbalanced presence of positive and negative feedback. Negative feedback plays the role of maintaining stability by countering initial changes, while positive feedback tends to reinforce the initial change in an attempt to increase instability. A situation may give rise to three kinds of outcomes, the first two of which are predictable behaviors and the third being chaotic. First, when independent of the time dimension, a system reaches an equilibrium state. This is called the *point attractor*. Second, the system may periodically arrive at an equilibrium state. This is called the *periodic attractor*. Third, it may seem that the system is behaving erratically. The erratic behavior would be dependent on the initial changes and the interplay of negative/positive feedback. This is termed as a *strange attractor* (see Figure 2). The strange attractor represents a situation which has been termed as deterministic chaos (i.e., the attractor is creating new order in the apparent chaos) by many Chaos Theoreticians. Clearly it is characterized by non-repetitive and non-predictable fluctuations that arise because of the concurrent interplay of negative and positive feedback loops. Deterministic chaos characterizes the nature of most organizational and social systems, i.e., dynamic systems governed by non-linear relationships (Thietart & Forgues, 1995).

Chaos Theory therefore could offer interesting insight into the analysis, design and management of information systems. Given a particular stage of information systems development, a certain facet of Chaos Theory can be used to interpret the possible consequences. In general a chaos analysis will indicate whether prediction is at all possible. Since in reality a large number of factors come together to determine a possible outcome, Chaos Theory offers an easy means of analysis[3] (e.g., non-linear processes such as genetic algorithms and neural networks can be used as tools for a chaos analysis). Since one of the tenets of Chaos Theory is that long-term predictions are impossible, a chaos analysis helps in identifying the right length of short-term predictability. The theory also helps us in understanding what drives systems out of short-term stability.

A CHAOS THEORY VIEW OF INFORMATION SYSTEMS

The purpose of this section is two fold. First, to identify those aspects of an IS that make them worthy of being considered from a Chaos Theoretic perspective. Second, to show through an illustrative example of the applicability of Chaos Theory concepts in studying IS.

Table 1: Some Examples of the Reasons for Such Assumptions

1.	The rapid rate of change of the underlying information technology, the variety of applications that can be created and the effects on individuals, organizations and society make prediction extremely difficult, even in the short term — the Internet being the latest unpredictable "phenomenon." Indeed, some IT suppliers see their route to success in "producing chaos" in the market (Protesch, 1993).
2.	The organizational and business environments within which IS are conceived, designed, implemented and used are themselves ever-changing "systems" which contain their own degrees of chaotic behavior (as argued by Thietart & Forgues, 1995; Parker & Stacey, 1994). While IS development lead times are shortening, there are no 'instant solutions' which would overcome at least the time-related problems, by reducing the gap between problem definition and solution realization.
3.	How individuals and organizations use information in decision making and evaluation is neither entirely rational nor consistent. Information when used is affected by contextual and situational factors, which cannot be pre-specified. 'Point attractors,' 'Periodic attractors' and 'Strange attractors' can all be identified in how information affects individual and collective decision-making.

Chaotic Nature of Information Systems

Our proposed use of Chaos Theory in IS research is based mainly on the following three assertions. First, that the long-term future of IS is inherently unpredictable. Second, predicting outcomes of change caused by IS is virtually impossible. Third, the notion that IS success is a function of adaptation to the environment is too simplistic. Table 1 gives a few examples to support these assertions. Chaos Theory has a lot to offer in terms of studying information systems because its principles address aspects of the assertions identified above. The following paragraphs explain these assertions in detail.

IS within organizations rarely represent an equilibrium state. This means that scarcely detectable disturbance in analysis; design and implementation can potentially get amplified to change the total behavior of a system within a very short period of time. This is exemplified in research by Dhillon (1997). He shows how a small irregularity in the design of a clinical information system resulted in human relation problems within the hospital. Such problems eventually affected the integrity of the whole organization. It is clearly impossible to forecast such irregularities so as to take considerable vigilance in detecting any disturbance. Therefore all exercises in simulating long-term behavior of systems experiencing 'chaotic dynamics' is pointless. Since the number of long-term outcomes are going to be infinite, any number of manageable simulated scenarios are not necessarily going to approximate the actual situation.

One of the implicit observations in the Dhillon (1997) study was that small disturbances in the organizational setting took a long time to get amplified. This means that although long-term prediction of systems' behavior is a farfetched idea, short-term forecasting is not. Therefore by managing the small-term behavioral disturbances and IS impacts, it is possible to manage the emergent chaotic situation. Chaos Theory proposes that there is always a hidden order in chaos. The order within an organization can be interpreted at two levels. First, at a micro level by interpreting small causes and effects. Second, by taking a more vitalist stance and interpreting the dynamics at a macro level. Analysis at these two levels will help in understanding the hidden order, which is inherent in the structure of the rules generating the behavior (i.e., the degree of irregularity in a specific behavior). Indeed there is little research to suggest why particular outcomes take place, which are based on events, apparently disconnected from the prime purpose.

A Chaos Theoretic perspective in business management takes a very radical viewpoint. It asserts that it is impossible to manage any major change in terms of its long-term specifics. This is because of the inherent unpredictability of such outcomes. It follows therefore that any outcome of a major information technology related intervention could not be assessed adequately. Moreover it will not be possible to control any specific aspect of information technology related change. At the most an environment conducive to change can be developed. This was illustrated in the case of the London Ambulance Service computer aided dispatch system. The grand designs of the system developers resulted in a complete project failure and abandonment of the system. While analyzing the outcomes of the system, Beynon-Davis (1995) notes that one of the primary reasons for failure was the complexity inherent in system design. Those in charge of the system development activities had a vision of controlling all possible outcomes. They failed miserably.

The analysis of information systems related change from a chaos theoretic perspective means that our focus should not be exclusively on controlling outcomes. Rather emphasis should be placed on the processes that lead to an outcome. In doing so the notion of grand control translates into 'control over the process of discovering' in an actual setting. Although this concept is at the heart of most risk analysis approaches, it is rarely used adequately.

Mainstream literature in business management suggests that in order to achieve success, a system must adapt to its environment. The notion of an environment is however confusing. In fact any one system may act as an environment of another system. This could possibly result in a sequence of events that have a chaotic affect on the behavior of all other systems. In this respect, the environment of a system should not be considered as given, rather it is consequence of interactions between different systems. It is therefore difficult to suggest a clear cause and effect relationship between a particular system and its environment.

A good example of dynamicity of the environment and its relationship to particular activities in a system can be found in the work of Kumar and Willcocks (1996). While considering outsourcing options available to Holiday Inns, Kumar and Willcocks show that although the options available appeared straightforward, environmental influences introduced a fair amount of complexity in the decision-making process. Initially, because of the internal disturbances within the organization, Holidays Inns had decided to bring in programmers from India. However, unpredictable complex contextual influences adversely affected the decision process. Regulatory requirements and economies of scale tilted the final decision towards offshore outsourcing. The Kumar and Willcocks study showed that there appears to be no straightforward cause and effect relationship between the rational decision to outsource and the actual realization of the outcome. This means that a good decision based on achieving an equilibrium state may not necessarily lead to success. In fact such equilibrium can never be achieved. This is because the environment within which the equilibrium is sought is itself constantly changing.

Studying Information Systems: An Example

Since information systems within organization are characterized by such dynamicity and turbulence in the environment, it seems obvious the Chaos Theory offers us relevant concepts to analyze, design and manage information systems. The question that may be asked at this juncture is: what do we do with the concepts of Chaos Theory? There are three possible directions. First, the Chaos Theory principles and the other related concepts can be used qualitatively to interpret current situations. This can be followed by reflexively thinking about all possible scenarios. Second, a more quantitative approach can be adopted, where various factors can be identified for a particular situation. This can be followed by a qualitative analysis of various relationships among the factors with the intention of generating some dominant patterns. Different levels of complexity can be maintained in this process, there could be a simple cluster analysis or more complex forms of attractors could be generated. Third, a combination of qualitative and quantitative methods can be used. The aim of this section is to illustrate the use of Chaos Theory principles in conducting research.

The Context of the Example

The research design described here was developed to undertake a detailed study of 11 cases of Strategic Information System (SIS) applications. The aim of the study was to examine the possible reasons for the relative success or failure of particular applications. Taking a more holistic approach than previous work identified various factors. This was in terms of its consideration of the whole application life cycle and the range of process and context factors included to fit the definition of Strategic Information Systems (more details about this can be found in McGolpin, 1996). The study was carried out in four steps:

1. A review of literature and initial fieldwork to elicit factors which were deemed to affect the degree of success in IS investments. This was based on the stages of an application life cycle (planning, evaluation, implementation and benefits realization).
2. Main field work where 11 detailed case studies were conducted. The choice and conduct of the case studies was guided by suggestions in Yin (1984).
3. Conventional quantitative analyses, using appropriate statistical techniques, were performed on the data, to identify factor inter-relationships.
4. The data was also analyzed by adopting a Chaos Theory perspective, qualitatively, using pattern matching software, to determine whether/which factors could be demonstrated to be significant across the range of degrees of success (i.e., an evaluation of the emergent structures, see Figure 1).

Given that nearly 50 factors were identified, each of which could have a range of values/attributes, both numerical and descriptive, and 11 case studies were involved, there is no space in this paper to describe the factor attribute analysis in detail (see McGolpin & Ward, 1997).

An Illustration

The research design described here identified four levels of SIS success — High Success, Success, Moderate Success and Unsuccess. The measure of success defined for this work was based on obtaining an agreed senior management view of the success, based on their perceptions and documented evidence of *the extent to which the expected benefits were realized or exceeded*. 'Expected benefits' means those benefits which were used to justify the investment.

The conventional analysis[4] based on statistics revealed a number of simple correlations, which clearly distinguished factors, related to *High Success* and *Unsuccess*. In reality, factors affecting the two extremes of success were readily distinguishable in the data and this analysis confirmed their significance. However it could not with any reliability determine differences between the other levels, nor identify related combinations of factors across the life cycle, thereby providing any explanation of the causes of the levels of success. This is a typical example of a situation where the study of 'local interactions,' although important, does not necessarily give the complete picture. With respect to the research design presented here, a simple case based analysis did not provide much insight either. Pettigrew's (1985) contextualist approach was used to collect the data. Although the theory used provided deep understanding of particular situations, e.g., the identification of certain socio-political issues, it fell short of providing an understanding as to which factors, in which combinations across the life cycle, came together to make an IT application highly successful, successful, moderately successful or unsuccessful. This supports the assertion made earlier in the paper, that most theories currently being used in IS research help in addressing only certain facets of the problem. It is our assertion that Chaos Theory provides an overarching conceptual framework that will help in organizing the research process.

In order to analyze the emergence of some relationships, the research design used the pattern matching tool — NETMAP. NETMAP is a set of computer programs, which identify and analyze formal and informal networks among data–both quantitative and qualitative in nature. It also produces a graphical; easy to interpret representation of the clusters identified. Its emphasis is on the analysis of patterns and relationships across large volumes of data.[5] An integral part of the NETMAP software is an analytical tool called Emergent Analysis. This tool was ideally suited to map out emergent relationships as complexity is added to the data set. This meant that it was possible to limit the relationships for generating patterns to a desirable level and subsequently trace the emergent complexity.

The ability to understand the patterns as different factors related themselves, shows the complexity that is inherent in IT projects. Clearly there is no single set of factors that determine success. In fact there are particular combinations of factors that would determine differences when moving from one level of success to the other. Figure 3 mirrors Figure 1 to exemplify the emergence of the intricate relationships between factors that determine the different levels of success. (Note: the contents of the analysis, i.e., the details of the factors, have been excluded from this illustration).

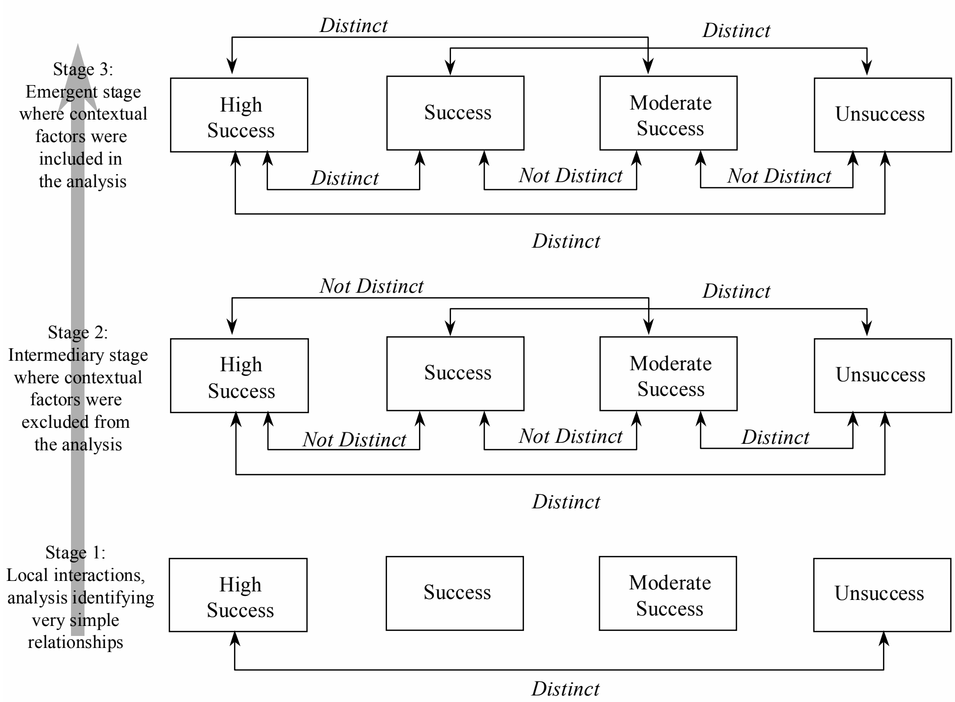
Figure 3 shows how traditional statistical analysis provided a limited understanding of the relationships. In many ways it suggests that if the problem domain is inherently complex, the majority of the statistical techniques will perhaps prove the obvious. It is limitations such as these that have been used by anti-positivist researchers to critique predominantly mechanistic explanations.

Figure 3 also shows three levels of an analysis. Stage 1 as mentioned earlier gave a simple explanation of a significant distinction between those factors that differentiated between High Success and Unsuccess. Stages 2 and 3, through the use of the NETMAP tool, helped to generate progressively emergent scenarios. Stage

2, to some extent, mirrors a simple negative feedback loop (see Figure 2). Clearly the analysis took the form of a closed feedback, with little contextual influence. Interesting results emerged when the contextual influences were added (Stage 3). In the second stage where the contextual influences had been ignored, analysis revealed that there was a distinct difference between factors determining unsuccess and all other levels of success. However as the analysis proceeded to Stage 3, where contextual factors were included, a different picture emerged. It was not possible now to differentiate between unsuccess and moderate success indicating that only systems development life cycle process and not contextual factors explain the difference but it is only contextual factors, external to the process, that differentiate High Success from Success. This means that had a simplistic approach been taken while conducting the analysis (i.e., analysis at any one level), the findings would have been incomplete and an inadequate explanation of the factors affecting the range of levels of success.[6]

Although we have presented a simple illustration of the complexity in research designs, it does make a point about the inherent chaos in actual situations. It also shows the emergent nature of a problem domain and how regular patterns can be identified, such that some order can be found in a potentially chaotic situation.

Figure 3: From Local Interaction to Emergence — A Typical Example



IMPLICATIONS FOR RESEARCH AND PRACTICE

The previous sections have explained the concepts in Chaos Theory and have made suggestions as to how these could be used in studying IS. The foremost intention of these sections was to show the richness in adopting Chaos Theory as a conceptual framework. In many ways Chaos Theory offers us a high-level meta-theoretical framework. It does not suggest any one particular technique, but since the main argument is to interpret order in chaotic situations, the theory does imply restrictions in choosing analytical methods, i.e., they should be non-linear.

In the literature there has been a lot of debate about bringing together quantitative and qualitative approaches (e.g., see Gable, 1994). The intention of such discussions has been to suggest the restrictive nature of research if one is strictly confined to one or the other approach. Clearly there is value in bringing together different viewpoints. There is however a more substantive task of understanding paradigmatic orientations. In the Burrell and Morgan (1979) tradition, it is virtually impossible to bring together the two opposing kinds of methodological approaches. This is because they differ in terms of their ontology, epistemology and an understanding of human nature. The four fold classification of Burrell & Morgan (1979) — functionalism, interpretivism, radical humanism, radical structural-ism, suggests that if a researcher is rooted in a particular paradigm, he/she will fail to consider the value and relevance of approaches rooted in another paradigm.

Chaos Theory, which does not have sociology as its reference discipline, addresses an issue that has only recently been considered important in sociology. Reference here is being made to the bringing together of different paradigmatic thoughts through meta-theorising (e.g., see the work of the American sociologist Ritzer, 1992). Ritzer, for example, is opposed to the paradigmatic divide advocated in works such as that of Burrell and Morgan (1979). He attempts to bring together philosophically divergent tool sets. Chaos Theory has always worked on this assumption. Many management theorists have taken on board the Chaos Theory concepts in their attempts to explain the complexity in organizational situations (e.g., see Thietart & Forgues 1995).

With respect to the discipline of IS, Chaos Theory is of value on two counts. First it can explain the chaotic nature of IS within organizations. Hence it comes in handy for a researcher to conceptualize about the problem domain. Since the goal of Chaos Theory is to find the hidden order, it introduces a structure and a purpose on the thinking of a researcher. One of the major criticisms of approaches in the more interpretive tradition has been that of rigor (although Walsham, 1995a, 1995b argues otherwise). Chaos Theory helps in overcoming this criticism.

Chaos Theory also holds out promise for practitioners. Often managers are confronted with situations where they may have to predict consequences for the future. Given the combination of the chaos inherent in the development and operational environment of IS and the complexity of sociotechnical systems, such predictions are not always easy. Even when predictions are made, the actual outcomes may not take the desired form. This questions the value of prediction and often confuses managers during their decision-making process. We argue that adopting a Chaos Theory orientation during systems design and development, for example, will help managers to understand the limits of predictability and the factors which will interact and affect the eventual outcome.

CONCLUSIONS

Researchers venturing onto new research projects often face three sets of issues. The first is related to understanding the nature of the phenomena or problem at hand. The second concerns the choice of theoretical and practical approaches to address the problem, and the third relates to the analysis and interpretation of the data and observations to ascertain legitimate conclusions from the evidence available. The concepts presented in this paper help us to address all three issues.

The majority of IS research to date has generally either sought to draw conclusions from simple statistical analysis of inevitably incomplete samples of quantitative data, or from detailed interpretation of a small sample of case studies representing unique situations. Chaos Theory, combined with new techniques for discovering patterns in complex quantitative and qualitative evidence, offers a potentially more substantive approach to understanding the nature of IS in a variety of contexts. We have argued that IS are developed and managed in chaotic environments, both business and organizational and that the processes of IS development and use are also inherently chaotic. Hence it would seem that by adopting a Chaos Theory perspective we could begin to study and perhaps understand the phenomenon more appropriately.

ENDNOTES

[1] 'Academic demolition' is a term used by Burrell and Morgan (1979) to describe attempts in critiquing theoretical standpoints. This is normally carried out by evaluating consistency of assumptions from the point of view of one's own problem area. Various authors have rejected academic demolition and have stressed the importance of understanding the nature of assumptions that underwrite one's point of view.

[2] Many authors have used terms such as Complex Systems Theory, Complexity Theory, and the Dynamical Systems Theory to refer to chaotic phenomena.

[3] Although complex computations and pattern generation could always be carried out mechanically, since the advent of electronic computers, it has become easier and quicker to carry out the computations.

[4] The correlation coefficients were subjected to a t-test to check statistical robustness (defined as t=*sqrt(n-2)/sqrt(1-r^2) by Lloyd, 1984). A multiple analysis technique, canonical analysis, was used to analyze the relationship between two sets of variables.

[5] The detailed data and the results of the analysis for the study described here run to some 90 pages of data, 40 tables and 28 cluster diagrams.

[6] These are just examples of the often very specific conclusions that were drawn from the many analyses carried out.

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Chapter XVI

Organizational Mission Statements: A Postmodernist Perspective on the Management of an IS/IT Function

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ABSTRACT

The mission statement embodies certain beliefs about the management culture of the organization, which can be examined and placed within underlying theoretical contexts. This chapter examines postmodernism in this respect, which, in addition to forming a critique of modernist approaches, posits alternative views about philosophy, organization and subsequently IS/IT management theory. The study applies an ethnographic case research methodology where data was collected from 16 interviewees employed within

a multi-national financial services group. In this way, the organizational mission statement was used as a vehicle for analyzing the contribution of postmodern approaches to the management of the IS/IT function. The influential Ashridge Model was adopted to map the findings of the study which suggest three propositions for postmodernism in providing: (i) cultural context, (ii) a textual or 'deconstructive' analysis and (iii) an ethnographic empathy for further IS/IT research. Finally, it is argued that the modernist/ postmodernist dialectic is ultimately a productive discussion, which can positively contribute towards research in terms of analytical techniques and interpretative strategies.

INTRODUCTION

Business requirements for successful IS/IT strategies increasingly demand changes in the way that we view the organization as a whole. A holistic approach is commonly associated with earlier research through "systems" theory (Checkland, 1981) and more recently "social" theory (Giddens, 1992; Walsham, 1993). However, these challenges to organizational and IS/IT research continue to be regarded with some theoretical pessimism. Theorists allude to "crises of organizational analysis" (Boje et al., 1996) or even "Saving IT's soul" (Davenport, 1994). Theoretical pessimism is supported by a poor record of success in IS/IT strategy where theorists are now frequently attacked as offering "fad management" solutions to business situations (Brooks, 1987). The overrunning of time and expenditure of IS/IT projects, and the failure of these management initiatives have sought to undermine confidence in dominant traditional approaches to IS/IT exploitation (Connell & Shafer, 1989). A popular management initiative is the introduction of organizational mission statements. However, despite widespread adoption (Boland & Hirschheim, 1991; Jones & Kahaner, 1995), it is unclear what effect they have at an organizational level. The specific research questions attempted within this chapter are identified as follows:

1. To what extent can an assessment of a mission statement implementation be informed by recent developments in cultural theory such as postmodernism?
2. In what ways can postmodern interpretative strategies inform discussion upon the management of the IS/IT function within an organization?

This chapter argues that an understanding of the philosophical determinants of existing management practices can help to build an awareness of the pitfalls of traditional approaches to the management of the IS/IT function. In this instance the organizational mission statement is the management practice under investigation where IS/IT initiatives can be informed by placing them within a postmodern "cultural" context. The methodology for this chapter is to undertake a philosophical and practical empirical analysis which is intended to inform the ongoing debate on the relevance of postmodern theory to IS/IT research. It is applied using a case study involving a medium-sized IS/IT company within a multi-national financial services group. In the case study postmodern contextualization is used to examine and interpret the implementation of a mission statement within a specific company. Organization and IS/IT theory are intentionally intertwined in this chapter. It is argued that the organizational context of IS/IT research is critical to the understanding of the effectiveness of the company as a whole. Vice-versa, an understanding of effective IS/IT is increasingly critical to the successful functioning of organizations (Feeny & Willcocks, 1998).

Little research currently exists of postmodernist theory in the organizational and IS/IT literature (Clegg, 1993; Coyne, 1995). This chapter proposes to extend the sociological field of IS/IT analysis to include "postmodern" aspects of cultural theory. Postmodernism has in fact been used for a number of years within the arts and social sciences (Foucault, 1980). Organization theory has to a lesser extent assimilated many postmodern concepts (Clegg, 1993; Boje, Gephart & Thatchenkery, 1996). With some exceptions (Coyne 1995), the application of postmodern cultural theory in IS/IT literature has been modest. Traditional modes of thought within science, IS/IT and organization theory are characterized by a typically "modernistic" outlook (McBride et al., 1997). The modernist tends to favor certain rational, centralized, structured methodologies (Winograd & Flores, 1986). However, a number of leading social and cultural commentators have proposed that the modernist framework has reached its boundaries, and new modes of conceiving society and the organization are called for (Gergen & Whitney, 1996). This emerging framework is frequently termed "postmodernism." These postmodern theorists indicate that modernistic approaches alone are no longer satisfactory due changes in the cultural contexts of events (Gergen, 1992).

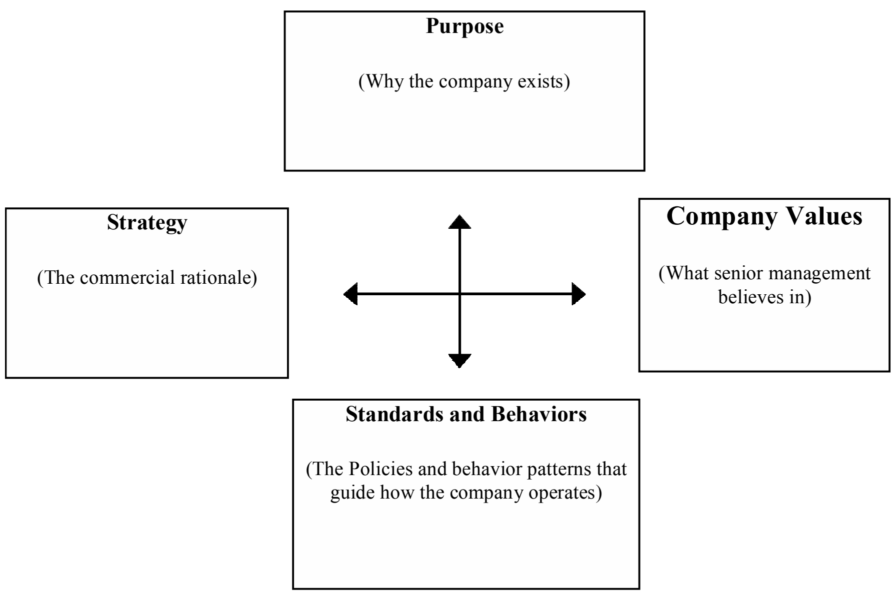
COMPANY MISSION STATEMENTS: THE ASHRIDGE MODEL

There is a reasonable amount of literature on the subject of company mission statements. Management writers and successful company bosses spanning a broad timescale endorse both the concept and production of mission statements (Watson, 1963; Ouchi, 1981; Sieff, 1987; Peters & Waterman, 1991; Foster, 1993). The ITIL Service Management Framework even suggests that every new project starts with the formation of a mission statement. The literature reveals that organizational mission statements are regarded as a popular management tool (Jones & Kahaner, 1995)

Campbell and Tawadey's Ashridge Model (1990) suggested the most comprehensive analysis and guide to mission statements. This framework will be used to explain what the mission statement is, why it is used and why it is perceived to be successful. The model divides the mission statement into four sections: Purpose, Strategy, Company Values, and Standards and Behaviors. These strands are illustrated in Figure 1, where each has a specific meaning. The Purpose relates to the philosophy of why the company exists. Strategy is the commercial rationale and "a definition of the business domain." Company Values are the "beliefs that underpin the organization's management style," paraphrased as "what senior management believes in." Finally Standards and Behaviors are "instructions on how people should behave," paraphrased as "the policies and behavior patterns that guide how the company operates." Campbell and Tawadey (1990) use this model as a template for the successful mission statements.

Campbell and Tawadey (1990) argue that organizational mission statements are important for a number of compelling reasons. These reasons are cross-referenced with the components of the Ashridge Model. They propose that the

Figure 1: The Ashridge Model for Mission Statements



(Campbell and Tawadey, 1990, p. 2)

mission statement is a motivator for the workforce, fostering commitment and belief in the jobs that people do. They argue that the successful mission statement results in belief, trust in the organization and meaning on top of pay. There are also benefits in improved communication. The mission statement assists in clearer communication of strategy, by helping to form identity through better understanding of self, others and the market that the company works in.

It is noted that the mission statement and the Ashridge Model are clear examples of the application of modernist theory through a rationalistic view of the organization. It prescribes an ordered framework for the production of a successful mission statement, which is itself premised on a belief in progress and cumulative knowledge about the organization. Mission statements seek to reduce uncertainty in the workplace and most prominently are a very obvious attempt to form general rules about the organization (McGinnis, 1981). The mission statement is, therefore, a centrally produced and managed information system. Also, the Ashridge Model targets setting a cultural agenda as a specific objective (Campbell & Tawadey, 1990).

ALPHA TECHNOLOGY SERVICES

Alpha Technology Services (ATS) is a medium-to-large IS/IT organization. Apart from a very few third-party contracts, the company provides IS/IT services solely to internal companies within the Alpha Bank Group. ATS employs approximately 2,000 staff members. The majority of staff are located in six data and support centers across the UK. ATS consists of various teams and departments structured around these key service areas. It runs four data centers in the UK, predominantly supporting mainframe processing. Alpha Bank has the second largest mainframe operation in Europe. Some mid-range systems are supported within data centers, and also at the client site. ATS maintains three "backbone" wide area networks linking the various Alpha Bank companies. ATS maintains these large-scale computer operations, both within the data centers and at support sites.

ATS came into existence when two separate IS/IT service providers within the group merged (Alpha Computer Operations and Alpha Network Services). This merger took place from mid-1995 to early 1996. Alpha Computer Operations had been mainly responsible for mainframe support and processing. Alpha Network Services, on the other hand, had been mainly responsible for networks and telephony. The mission statement for ATS is stated as follows:

> *Our mission is to become the chosen provider of those technology infrastructure services critical to our customers' success.*

The mission statement was implemented alongside six specific Key Result Areas (KRAs). The intention was to link each KRA back to the mission statement. The KRAs were to be used as a method of measuring the success of Alpha Technology Services; the KRAs are:

1. Ensure client loyalty
2. Develop the right processes
3. Win the right business
4. Demonstrate excellent financial management
5. Develop the right skills and competencies
6. Ensure high staff motivation

The KRAs were implemented using a process of "management by contract." Projects and "business as usual" tasks that the manager was involved with were related to KRA objectives. Managers were contracted to meet these objectives. Managers in turn wrote individual contracts with each of their staff, relating each task back to the objectives outlined in his or her own contract. At roughly the same time as the implementation of KRAs, ATS formed a Business Excellence team. The Business Excellence team took on ownership of the Total Quality Management (TQM) program, the ISO9000 Quality Standards program and overall mission statement communications. The TQM program had originally started in 1992 as a group-wide initiative, based on a packaged system of training manuals and implementation strategy marketed by a large external consultancy company. Company-wide ISO 9000 accreditation was sought (and achieved) by ATS in 1997. In order to reinforce the link between quality and mission, the ATS managing director issued the following statement in January 1996:

> *Our mission is to become the chosen provider of those technology infrastructure services critical to our customers' success. This can only be achieved by an absolute and on-going commitment to Total Quality and Continuous Improvement from all people that work within ATS.*

RESEARCH METHODOLOGY AND FINDINGS

Qualitative methodologies were used in data collection and analysis of the research topic. It was felt that the qualitative/ethnographic techniques employed fitted well with a postmodern approach to field research. Formation of the research methodology involved a substantive literature survey (Hammersley & Atkinson, 1993; Yin, 1994; Kincheloe & McLaren, 1990; Harvey, 1997; Walsham, 1993; Orlikowski, 1992). The ultimate purpose of the data collection was to gain an insight into the implementation of a modernist type of initiative. For this reason, most questions were built around the Ashridge Model for mission statements.

The interviewees formed a cross-section of Alpha Technology Services. The structural hierarchy of the organization divides IT employees by eight pay grades: IT1 to IT8. IT1 roughly equates to director level, IT8 roughly equates to trainee level. Although the opening question was closed, the vast majority of questions were open. This was done in order to encourage the respondents to elaborate on their answers, and to avoid leading respondents to "yes/no" answers. However, it is emphasized that the semi-structured framework of the interview merely outlined points to be covered. Many other areas were also covered. Respondents frequently shifted quite widely from the research topic, for instance citing personal anecdotes seemingly quite tangential to the discussion area. These comments were all recorded and analyzed within the context of the data. When the interviews had been transcribed, each text was examined for themes and key quotations.

Organizational Mission Statements as Vehicle for Analysis

The organizational mission statement lends itself to analysis by those interconnected areas of interest to this chapter: philosophy, organization theory and IS/IT management. The organizational mission statement can be viewed as a classic modernist project. The objectives of mission statements, as outlined in the Ashridge Model above, are premised on an objective-rational view of the organization. Mission statements take a rationalistic view of the organization. Models such as the Ashridge Model offer an ordered, structured methodology for producing a mission statement. The mission statement is a conscious attempt to reduce uncertainty in the workplace, for example in decision making.

Most prominently, the mission statement is a very obvious attempt to form general rules about the organization (McGinnis, 1981). The functions and objectives of an organization are whittled down to an essential aphorism or statement. In a somewhat logo-centric manner, the mission statement tries to be trans-historical, an essential truth, a basic given. The mission statement is a central authority, most often produced at the top levels within a company, asserting a homogenized view of the organization. In this respect, the mission statement is a mass communication media throughout the organization.

Modernist views of organization theory are characterized by certain themes. The organizational mission statement is very much located within the vision, goals and strategy mode of modernist organizational thinking. The Ashridge Model specifically targets these three factors (Campbell & Tawadey, 1990). As with the ATS implementation, the mission statement is also perceived to sit well with the TQM ethos (Peters, 1991), and proposes the composite objective of "building in" or "investing" the mission at every stage of production by each component (Peters, 1991). In its entirety, the implementation of the organizational mission statement is a re-engineering process, in which staff opt in or opt out. In fact, the formation of the mission statement or a change in the mission statement is frequently associated with change programs or redefined objectives.

Mission statements are a form of information system in their own right. The Ashridge Model sets a standard model, and hypothesizes that a successful mission statement exemplifies certain general rules (Campbell & Tawadey, 1990). They developed a questionnaire checklist for readers to assess their own company's mission statement (Campbell & Tawadey, 1990). The mission statement is also a linguistic production that is communicated to a very wide audience. In recognition of these technological features, Gergen and Whitney (1996) refer to mission statements as a "technology of representation." In most cases, the users (staff in the organization) have a "yes/no" option of endorsing the mission statement. As such, the mission statement tends to be produced and implemented in a top-down way that differentiates between the originator and user (Gergen & Whitney, 1996).

Interpretative Strategies: Postmodernism

Postmodernism can be applied in order to explore the theoretical context of the implementation of the mission statement within Alpha Technology Services. Fundamentally, the postmodernist will be suspicious of imposing a "grand narrative," or over-arching statement on the purposes, strategy and beliefs of the organization (Lyotard, 1984). The postmodernist will approach the mission statement in "deconstructive" mode. The production of the mission statement tends to imply shared understanding throughout the company. A theorist such as Derrida (1978) would argue that this is a hopeless task. The mission statement will always mean different things to different audiences or individuals. Each individual has an alternate context within which they view the mission statement, or indeed any signification. Paradoxically, the attempt to unify meaning within the organization seems, in the view of many interviewees, to have highlighted the multiplicity of cultures within the organization.

The mission statement implementation within Alpha Technology Services evidences the recurrent postmodernist theme of the "vanishing author" (Gergen & Whitney, 1996). Within the organization, it was unclear to each of the interviewees (even high-graded personnel) exactly who created it, and even how the mission statement had been created. This distancing between author or authors impairs the communication processes involved with the mission statement (Gergen & Whitney, 1996). The fact that a small group of executives actually devised the mission statement tends to highlight an apparent or actual distancing between senior executives and lower graded staff. To some lower graded staff, the authors of the mission statement are like an anonymous being, imposing values or "truths" on the masses of the organization. Derrida (1978) terms this tendency to impose essential truth as "centering." In this formation, the executive board members place themselves in the position as both "center" and "ultimate referent" for the dominant discourse.

A key factor within the ATS mission statement implementation is that lower grades have no control over this particular discourse. All interviewees cited the executive board as the owner of the mission statement, and that only they had the ability to change the discourse. In this way the recipients of the mission statement (all staff below the board) are marginalized in the sense that they are "de-centered" from those higher graded staff who create the organizational "logos" or mission statement. Ambiguity over the identities of the creators of the mission statement has actually resulted in a closure of communication channels from the top to the bottom of the organization within Alpha Technology Services. The data-collection phase of the research application revealed that the senior managers were generally aware of the lack of "buy-in" from lower graded personnel. However, the mission statement implementation within Alpha Technology Services provided no scope for feedback or dissent. Most interviewees (whether low or high graded) felt that every employee was a stakeholder in the mission statement, yet employees were not invited to participate in the formation, implementation or maintenance of the company mission statement.

Another factor that emerges from the data collection is that there is no clear and consistent understanding on what the purpose or function of the mission statement is. Some interviewees felt that the mission statement was intended to align with the KRAs; some interviewees felt that the mission statement was completely separate from the KRAs. Views on the purpose of the mission statement ranged from "it's an advertising slogan" (IT3), to "for people to benchmark to how well they are living up to their goals and objectives" (IT8), to "so that we can say what Alpha Bank is striving for" (IT4). One interviewee (IT7) felt that the mission statement should come after a "vision" had been formed, then later in the interview changed his mind. He concluded by saying: "My thoughts are, I'm a bit confused." One interviewee (IT4) felt that the mission statement was somewhat superficial: "It sounds good but there is not much substance behind it."

Deconstruction of the mission statement presents opportunities for "resistance" postmodernist interpretative strategies. The resistance postmodernist tends to emphasize the political determinants of the situation. If there is a closure in communication between high- and low-graded staff, and if it is unclear exactly why there is a mission statement in the first place, then perhaps social or political analysis can help to define the motives underlying the formation of the mission statement. Evidently, the mission statement is part of a specific discourse. This discourse seems to have complex values across the grading structure. Both lower down and higher up there is skepticism. One interviewee (IT5) described this discourse as "business school" terminology, another (IT4) described the mission statement as "a management fad." Higher up there was some degree of skepticism, but there was also acceptance of mission statements as a management tool.

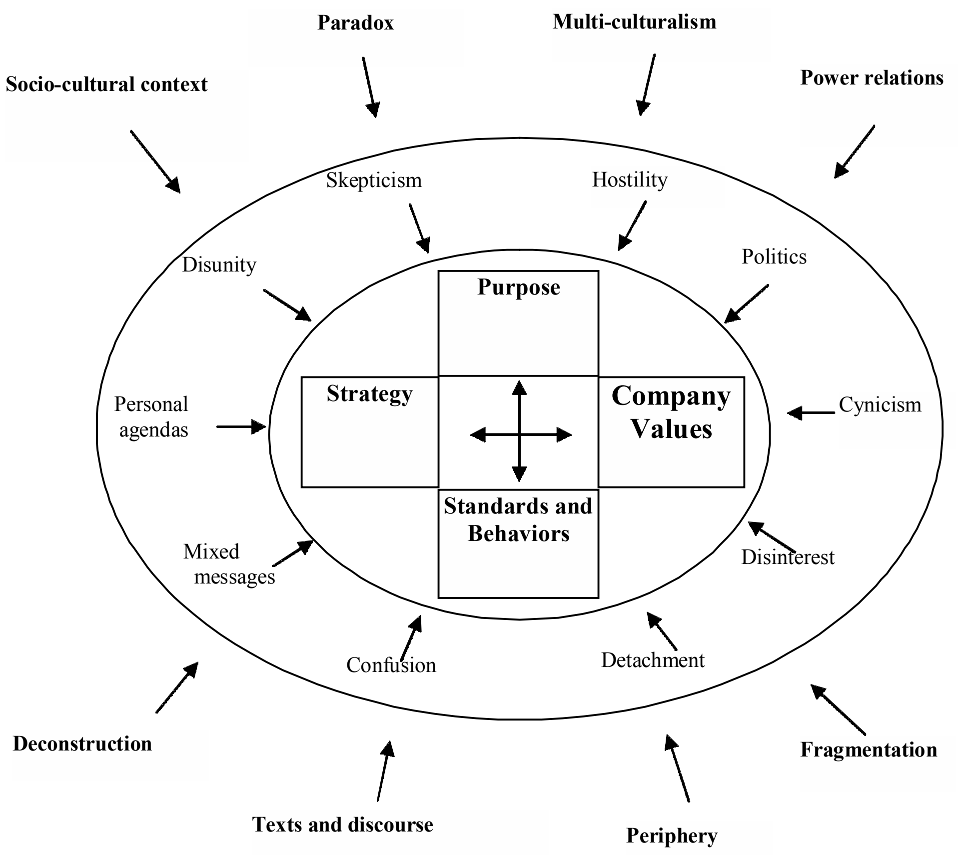
Another IT5 characterized the mission statement as a typical test within a recruitment context. He proposed that knowledge of the mission statement and KRAs were a way to progress within the organization. This view of the mission statement is a long way from that envisaged by the executive board that originally devised it. A parallel can be drawn to Orlikowski's (1992) findings, from her interviews with Beta consultants using CASE tools. Working around or bypassing the company mission might be viewed, like Orlikowski's Beta consultants, as not being a "team player" (Orlikowski, 1992). The ATS mission statement is also used by this IT5 in a similar "workaround" way.

Certain cultural models and theories can inform these observations in order to explain events. Bakhtin's (1984) "dialogic" interpretation of social power dynamics can also be related to mission statements. Firstly, Bakhtin (1984) makes a distinction between "monologic" discourses and "polyphonic" discourses. He uses the example of the literary novel, but the model is equally transferable to an organizational context. The monologic form of the novel is where the voices of characters are sub-ordinated to an authoritative discourse. By contrast, in the polyphonic novel, characters, voices are independent, plural and unsuppressed by a dominant narrative. The monologic novel is governed by the social structures created by authoritative voice of the author. On the other hand, the polyphonic novel tends to mock authority, flout social norms and invert social hierarchies.

In this view, the mission statement is a management tool that proposes a monologic discourse within the organization. Since the company is made up of numbers of people, by definition the company has multiple discourses or a polyphony of voices. Two alternative positions are considered in order to address this dichotomy.

Figure 2 extracts the themes summarized and conceptualizes the pressures on the Ashridge Model for mission statements in postmodern terms.

Figure 2: Postmodern Conceptualization of the Pressures on the Ashridge Model for Organization Mission Statements



POSITION 1: COMPROMISE

The first position is based on a compromise between the conflicting monologic/polyphonic discourses at the organizational site. Within Alpha Technology Services there are varying levels of conformity or support of the authoritarian discourse represented by the mission statement. From data gathered within the interviews, this conformity is generally linked to seniority within the company. Criticism of the mission statement, or the authoritarian discourse, came from all levels of the organization. However, there was little criticism per se of the motives for having a mission statement. Even those interviewees that were highly critical of the Alpha Technology Services mission statement believed that mission statements could be useful. There were many instances where the mission statements of other companies were cited, or alternative suggestions were provided.

One important finding was that, in an organizational context, almost all interviewees felt that there was a place for a mission statement. In this sense there was strong support for the mission statement and the principles asserted by the Ashridge Model. Even those interviewees that were most critical of mission statements at the start of the interview expressed support for the concept of the mission statement. The question is: If mission statements are broadly supported across the company, why was the implementation a failure? One explanation is that while the directors have identified the need for an authoritarian discourse within the company, they have failed to take into account the implicit polyphony across the organization. The data collected from the interview phase reveals both the polyphonic and monologic modes of discourses in the company. Therefore in subsequent mission statements and other projects, the directors might consider a more participative approach to implementation. In this case the top-down approach is tempered by attention to communication and staff feedback.

POSITION 2: RADICALIZE

The second position takes an altogether more radical view of implementation within the organization. This view proposes that the structure of the organization needs to change in order to adjust to the challenges of polyphony and postmodernism more generally. This proposal, a polyphonic re-definition of the organization, has fascinating implications. In Alpha Technology Services this would mean an abandonment of the central establishment voice. Instead employees would be empowered to speak with their own discourse, making their own agendas explicit. This would make the mission statement redundant. Alternatively each member of the company would have their own mission statement, if they so chose to have one. There would be no central validating authority to check for consistency.

The criticism of this formation of the organization is that it would result in chaos (Gergen & Whitney, 1996). The mission statement, Key Result Areas and management by objectives are all mechanisms within Alpha Technology Services designed to keep every employee on track. Surely polyphony would represent a potential threat to this kind of order? Gergen and Whitney argue that this may not be the case. Rather, they suggest that there is the possibility of a "unifying disorder" (1996, p. 356). They draw parallels with recent developments in chaos theory that suggest that chaos actually results in a form of unity. In fact this is consistent with Bakhtin's (1984) original concept of polyphony. In his discussion of polyphony, Bakhtin suggests that there is a dimension beyond anarchy and carnival. Bakhtin (1984) proposes that polyphony actually results in its own order: "a unity of a higher order."

CONCLUSION

In this chapter it is proposed that the contribution of postmodernism to IS/IT management and organizational research can be divided into three strands:

1. Postmodernism as socio-cultural context
2. Postmodernism as technique: textual or deconstructive analysis
3. Postmodernist research methodologies: ethnographic empathy

Postmodernism as Socio-Cultural Context

A number of leading theorists propose that postmodernism has applications in terms of socio-cultural conceptualization. For example, Gergen (1992) argues that modernism, the traditional basis for organization theory, is actually in retreat. For Gergen, modernism has begun to lose its theoretical appeal due to cultural changes, or rather a change in the *context* of the debate. This argument is based on the proposition that modernism is out of synch with the "spirit of the times" (Hassard, 1996, p. 57). Gergen proposes that the emerging discourse of postmodernism has greater explanatory power than traditional bases of organizational theory. Poster (1990) also argues that a "mode of information" is supplanting previous modernist socio-cultural formations. If modernism is indeed incongruent with the cultural realities of contemporary organizations, then the premises that support it need to be examined. Correspondingly, if a postmodern view of socio-cultural formations is thematically closer to the overarching paradigm, then its propositions may help to conceptualize theory and empirical research.

Postmodernism as Technique: Textual or Deconstructive Analysis

The second facet proposed by this chapter is that postmodernism can offer new directions in critical theory. Clearly the postmodern mode relies heavily on a textual emphasis, or discourse analysis, which embodies multiple meaning. The result is a skepticism to traditional theory that is intended to subvert or resist modernist rules of homogeneity. The postmodern interest in unorthodoxy gives opportunities for theorists from other disciplines to make a research contribution thus enabling a multi-disciplinary approach.

Postmodernist Research Methodologies: Ethnographic Empathy

Thirdly, it is argued in this chapter that a postmodern research methodology would tend to favor ethnographic methods. This assertion is made due to postmodernism's textual emphasis, its interest in the peripheral and its reluctance to generalize. A number of researchers (Gergen & Whitney, 1996; Harvey, 1997; Kincheloe & McLaren, 1994; Aronowitz & Giroux, 1991; Hammersley, 1990), advocate ethnographic research techniques as fitting well within a postmodern context. Postmodernism is in essence a cultural movement and so in an etymological sense ethnography—"ethno" (culture/race) "graphy" (writing)—would appear to be a natural choice. The ethnographic data-collection process produces narratives that are analyzable as if they were texts (Kilduff & Mehra, 1997). Also, the ethnographic approach is premised on multi-cultural perspectives of the organization. The consequence of this approach is believed to offer a richer and deeper understanding of cultural norms within organizations which provide for more valuable insights into the management of the IS/IT function.

The Modernism/Postmodernism Dialectic

One fundamental feature of postmodernist theory is that it actually makes us look at modernism more closely. In fact there are theorists such as Giddens (1992) and Habermas (1987) that explain the emerging trend towards postmodern theory as simply a development of the modernist tradition. Giddens (1992) terms the phenomenon often described as postmodernism as "high" modernism. He sees postmodernism as a radical form of Enlightenment skepticism (Giddens, 1992).

Like Giddens (1992), Habermas (1987) emphasizes the prefix "*post*" in postmodernism; that is the next phase in the development of the ideology. Habermas could be described as a critical modernist. This term is used because Habermas actually embraces much of postmodernist skepticism, but at the same time mounts a critique of the postmodern position. Habermas (1987) criticizes the postmodern movement as "neo-conservatism and aesthetically inspired anarchism." By this Habermas means that without political responsibilities, postmodernism is a kind of "decadent" aesthetic preamble.

Although in many ways Habermas (1987) offers a compromise position, he comes firmly from the modernist camp. Also occupying a compromise position, but coming from the postmodern direction, is the resistance postmodernist approach that is described above. The convergence of resistance postmodernism and critical modernism is compatible with the view that postmodernism is simply a form of high modernism, or the next stage in the development of the project (Giddens, 1992). This position implies that all the heat and attention that postmodernism generates is largely due to the anxiety for certainty. Uncertainty is based on the spirit of skeptical enquiry that is part and parcel of academic research. In many ways modernist and postmodernist views oppose one another, but in many ways it is also seen how they compliment each other. It is proposed that the modernist/postmodernist dialectic can help to conceptualize business problems in challenging and engaging ways.

In this chapter it has been argued that ultimately the modernism-postmodernism debate is a constructive discussion. The dialectic between the modernist and postmodernist positions in itself gives a critical edge to theory. This results in a situation far removed from the theoretical pessimism espoused by some theorists. Rather, the modernist/postmodernist dialectic opens up new avenues for discussion and ways of looking at the research environment.

Finally, it is proposed that there is scope for further development of postmodern perspectives within IS/IT and organizational research. The real test of the validity of postmodern perspectives for IS/IT research is applicability to practical business situations. In this chapter the postmodern perspective has helped to define and understand an everyday business initiative: the organizational mission statement. Further studies will be required to test whether the postmodern perspective can help IS/IT researchers to define, conceptualize and interpret events.

This chapter has sought to introduce some of the major concepts and approaches of modernist and postmodernist theory. Within the case study, and specifically in the context of organizational mission statements, some suggestions have been made on how to operationally this theory in an organizational research context. It is argued that the application of both "postmodernist" and "modernist" perspectives can offer new insights into current organizational problems.

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