Perceptions of the Relative Importance of Conditions that Facilitate Implementation

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ABSTRACT

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Implementation is a phase included in nearly all instructional development models, yet literature on instructional design and technology reveals little about implementation's nature and the special conditions that must be considered as users go beyond adoption (Ely, 1999). Ely (1990b; 1999) contends these conditions include dissatisfaction with the status quo, leadership, commitment, participation, resources, time, incentives and rewards, and knowledge and skills. When employing Ely's conditions as a framework for investigation, attention is shifted away from the innovation to the environment where the innovation has actually been adopted and utilized as a facilitating factor in implementation. The move to online and software-based environments in recent years is accompanied by a need for additional research to further validate Ely's conditions within this new context. This exploratory study identified and analyzed user pre and post-implementation perceptions regarding the relative importance of Ely's conditions for the successful implementation of an actual innovation, a product management system. An online survey, the Implementation Profile Instrument created by the founders of iphase.org, was adapted and utilized to capture user perceptions. Descriptive statistics and factor analyses revealed important differences with past innovations and contexts, and between pre and post implementer groups and pre and post-implementation stages.

DEDICATION

To my parents, Bobby and Wanda Brown, and my family for their support and encouragement.

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CHAPTER 1: INTRODUCTION

Ely (1978; 1990b) believes that eight conditions facilitate implementation of instructional technologies and that the absence of any one condition can impede success. These conditions are 1) availability of time, 2) existence of knowledge and skills, 3) leadership, 4) participation, 5) availability of resources, 6) commitment, 7) rewards and incentives and 8) dissatisfaction with the status quo. A theoretical basis for the existence of these conditions resides in literature within the field of diffusion of innovation theory and systems theory, both of which provide an understanding of factors associated with implementation. Although these conditions have been found among both technology and non-technology-based studies in other cultures and countries (Ely, 1978; 1990a; 1999), there are a limited number of studies that have investigated implementation of recent computer and Internet-based technologies (Bauder, 1993; Burton & Danielson, 1999; Surry, Ensminger & Miller, 2003; Ravitz, 1998).

Rationale for the Study

The goal of this study was to address Ely's (1999) propositions by identifying adopter perceptions about the degree of importance of this predetermined set of conditions for the successful implementation of a relatively new and unstudied innovation within an organization. Ely (1999) first identified these conditions in 1975 and further validated them through a selective international investigation in 1989. Based on nearly 15 years of research, Ely concluded in 1990 that these conditions, from both technological and non-technological cross-cultural studies, are important for successful implementation. Since Ely's publication of these results in 1990, these conditions have been further confirmed through a recent review of other sources in the literature; however, only a limited number of dissertations exist utilizing the conditions as a framework for investigation of the implementation of specific instructional technology innovations (Ely, 1999). Nearly 10 years after Ely's initial publication, Ely (1999) suggested that research is needed to confirm their existence, importance and the reliability of the framework with more recent technological innovations.

Ely's (1999) conditions have been traditionally studied in a context where the innovation has been actually implemented and used (as his framework stipulates), as opposed to investigations of planned or anticipated use. However, Ensminger (2001) proposes that these conditions can also serve more as a proactive approach toward product implementation through an assessment of these conditions at various stages of the design process. As a more proactive approach to ensuring successful implementation, recent research efforts have assessed the importance of these conditions prior to implementation as a means of allowing designers and change agents the opportunity to address these issues during the planning stage in order to develop an implementation plan "tailored to the organization" (Ensminger, Surry, Porter, & Wright, 2004, p. 14).

A variety of technologies exist within the realm of IT, and only a few have been assessed in the literature using Ely's conditions as a theoretical framework for implementation. From a change agent's perspective, it is imperative to look at both business and educational systems in order to better learn of the interrelatedness among them and to provide insight into the goals and implications of an innovation (Ellsworth, 2000). As a means of improving information

management and collaboration, many corporations have adopted related software tools. An engineerging firm in the United States is one such organization that has adopted a product information management application, and provides the context or system and innovation, respectively, for investigation in this study.

A leader in the field of implementation is Daniel Surry at the University of South Alabama. Surry and David Ensminger are founders of iphase.org, an organization established in 2002 to promote research related to implementation (D. W. Surry, personal communication, January, 2004). The organization's Implementation Phase Research Project is described as a "collaborative project comprised of university faculty and graduate students interested in implementation and change" (iphase.org). Evolving from past research by the founders, its recently developed Implementation Profile Instrument is intended to measure the relative importance of Ely's eight implementation conditions, perceived by individuals prior to the implementation of a new innovation, as an initial step toward developing a successful implementation plan. This study utilized Ensminger and Surry's Implementation Profile Instrument (iphase.org) to assess the relative degree of importance of Ely's (1990b) conditions in the implementation of a product management software application as perceived by engineers at an engineering firm.

Analysis of the data of this study sought to determine 1) adopters perceptions toward the relative importance of Ely's conditions, 2) if perceptions regarding the relative importance of Ely's conditions differ between pre-implementers and post-implementers, and 3) between pre-implementation and post-implementation stages. It is hoped that a real context will help to further substantiate the instrument and importance of these conditions from pre and post-implementation investigations. Results may encourage further investigations into the ability or inability of these conditions to reliably predict successful implementation of more recent technological innovations, and consequently contribute toward establishing a hierarchy of Ely's conditions that ultimately could guide policymakers, educators, and instructional designers in the design and implementation of future technologies.

Limitations of the Study

As noted earlier, Ely (1999) cautions that his identified conditions cannot be specific in determining the exact causes of problems of adoption and implementation due to the affects of culture, setting, adopter and innovation attributes on the efficacy of the conditions. Rogers' (1995) theories of diffusion similarly present this multitude of influences. Ely believes the setting determines the utility of the conditions. In other words, the framework can be influenced by both the innovation and context. Some argue that the attributes of the innovation pose more limitations (Leonard-Barton, 1988). Consequently, the importance of Ely's conditions may be specific to this innovation and context. However, consistencies in terms of the presence of these conditions and perceived importance, from innovation to innovation and place to place may exist. An inventory of these conditions and their strengths may serve at least as an indicator of areas for improvement or potential problems with the implementation process, as well as what is being done correctly to foster use.

Surry (2003) acknowledges limitations of the Implementation Profile Instrument in that it is not intended to be the "be all and end all" of research into implementation, “but a tool for getting started and generating interesting questions” (D. W. Surry, personal communication, November, 2003). Ravitz (1999) acknowledges that the presence of these conditions may be outcomes of use, and use may also be attributable to the expected benefits followed by observed benefits. Bauder (1993), Ravitz (1999) and Ensminger (2001) also acknowledge that interrelationships between conditions, the presence of one condition being dependent upon the presence of another, “make measurement of individual conditions and their effects more difficult” (Bauder, 1993, p. 84). Demographic variables, including the experience level of participants (Hall, George and Rutherhord, 1998; Lewis and Onton, 2001; Ravitz, 1999), as well as sample size, participants, and this particular innovation studied may prevent results from being generalized across innovations, contexts, and populations.

CHAPTER 2: REVIEW OF THE LITERATURE

The review of literature presented here investigates conditions for the successful implementation of technologies with an emphasis on implementation of instructional technologies. Two frameworks of change, diffusion of innovations theory and systems theory, are examined as a foundation for understanding the innovation to implementation decision process. Research dealing with these two frameworks is discussed and the relevance of this research to the implementation of instructional technologies is reviewed. Finally, areas for further exploration are identified.

Investigating Change

Defining and Understanding Change

Change is defined as a continuous process of transforming the status quo, or transitioning from the status quo. One type of change is innovation, "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers, 1995, p. 11). Because "acceptance or adoption of an innovation usually demands some type of change, …innovation infers change" (Ely, 1978, p. 151). This process of change occurs when an individual or institution adopts and implements an innovation. As a result, transformation of the status quo and diffusion of the innovation, "a process by which an innovation is communicated through certain channels over time among members of a social system" (Rogers, 1995, p. 5), begins.

Understanding change and its processes is to recognize that change is not mass innovation or necessarily having the best ideas, but the capacity to take good ideas, and through interaction with others inside and outside of an organization, produce results that are a consequence of the two-way interaction (Fullan, personal interview, Cisek, 2002). People ultimately adopt or reject innovations. Spicer (1952), speaking of technological change, states "changing peoples' customs is an even more delicate responsibility than surgery" (p. 13) because "changes in one aspect of life will have repercussions on other aspects" (p. 17). Spicer further contends that people resist change they do not understand, or change that is perceived as threatening or forced. Such resistance or obstacles within the change process are climactic points that allow one to identify relationships needed for the change process. Change is a "re-culturing" process that affects the way people interact; it is a complex phenomenon in that there is no blueprint or "checklist approach" to change, but, instead, requires an understanding of the dynamics of change (Fullan, 2002). In spite of the resistance and complexity, change among people and organizations does occur and is constant as evidenced from generation to generation.

Change is multifaceted and because of this, it is "an elusive area of research…difficult to discuss in simple, empirically-based paradigms" (Ely, 1978, p. 152). It is affected by political, socio-cultural, economic, and socio-technical issues such as vested interests, attributes of the innovation, attributes/characteristics of the adopter, adopter attitudes, perceptions, and communication channels (Rogers, 1995; Surry & Gustafson, 1994); value judgments (Schorger, 1997), and personal motivation factors (Medlin, 2001). Outcomes of change can be latent (Boone, 1992), and the process can be slow (Byrom, 1998; Green & Gilbert, 1995), particularly

in educational systems which are usually "loosely coupled," where information sharing is often stagnant due to faculty autonomy (Ehrmann, 2001).

Facilitating Change

Change is facilitated by interrelated conditions including the environment, infrastructure, context, innovation and adopter attributes, relationships, customs, norms, values, leadership, participation, commitment, resources, rewards and incentives, time, skills and knowledge, and trust (Ely, 1999; Rogers, 1995). The conditions for change can be cultivated through strategic and systemic planning, marketing, collaboration, feedback and a shared vision. These conditions are influenced by perceptions and attitudes indigenous to a specific perspective toward the status quo and innovation as established by the culture of a system. Perceptions toward the status quo and innovation consequently facilitate or hinder a change process that is continuous and inevitable in evolution whether it is social-technical, economical or political.

The process of change involves addressing the goals and needs of users (Kershaw, 1996; Stuhlmann, 1994; Troxel, 1994) and is facilitated by cooperation and collaboration, identifying and involving stakeholders, and adopting the philosophy and understanding the culture of the organization (Boone, 1992; Ehrmann, 2001; Jacobsen, 1997). It is a systemic process (Cradler, 2000; Ellsworth, 1997; Ely & Surry, 1999; McMaster et al., 1997; Rogers, 1995; Reigluth, 2002; Tatnall, 2001), and is encouraged by innovations that allow for re-invention and adaptation from users moving toward self-reliance (Byrom, et al. 2000; Daniels & Starken-Meyerring, 1999; Harris; 1994; Rogers, 1995;). Technology integration issues surround change (Byrom et al. 2000; Jacobsen, 1998; Kearsley, 1983) such as the development of supportive infrastructures (Carter, 1998; Katz, 2002; Marcinkiewicz, Robinson, & Surry, 2001). In educational settings, factors affecting successful integration include perceived value, ease of use and willingness to adapt, support from facilitators and other teachers, access to the innovation from home, and a stable environment/infrastructure where teachers understand their roles (Stuhlmann, 1994). Appendix A presents a more exhaustive list of conditions uncovered from an extensive review of the literature.

The Context of Change

Change is situation specific; the environment in which an innovation exists affects the strength of a change condition, and any generalizations regarding research are only valid when applied to an actual context …"in a specific field, involving specific materials and relationships among people" (Ely, 1978, p. 153). Ely (1990) stresses the importance of assessing a) the context of change, as the innovation is "usually adapted to the norms of that environment" (p. 299), and b) the unit of analysis (such as teachers) through which implementation is measured.

Technological innovations and their implementation often require supportive infrastructures to be established. Katz (2002) sees infrastructure as "a driver of change" in information and communications technologies whereby changes in hardware, networks, leadership and skills, budgets, and policy must occur for new technologies to reach their full potential. Jacobsen (1998) believes the key to diffusion of an innovation is training and support, both components of the infrastructure. In education, Ellsworth (1997) believes the difficulty in

adoption and change lies in the complexity of the educational system itself whereby learning theory, infrastructure, support, and funding affect the utility of the technology. Carman (1999) and Carter (1998) have also acknowledged the importance of infrastructure.

Infrastructure can promote or inhibit change, but the apparent presence of adequate infrastructure does not ensure change. Berge and Muilenburg (2001), concerning obstacles in distance education at higher education institutions, question whether certain barriers decrease or others surface depending on the maturity of the infrastructure. Their study revealed that barriers perceived are fewer and less intense with an established and capable infrastructure.

From a social-technical and cultural perspective, changes in the form of transformations to online environments reveal faculty concerns for academic autonomy in terms of scholarship, creativity, critical inquiry, intellectual development, choice in delivery mode, and control over course content (Lewis, Alexander, Farris, & Greene, 1997). However, over a period of two years Stuhlmann (1994) investigated technology integration within the University of Virginia's initiation of a collaborative effort between the Virginia Department of Education and public school divisions in Virginia through the formation of the Electronic Academical Village Project. Analysis revealed that despite support, training, access to equipment, state-of-the-art facilities and active facilitators, integration and use was not prevalent among all teachers; similar results of IT use have been found by Burton and Danielson (1999).

Change and the Organizational System

It often seems the greatest barrier to change in the educational system is the educational system itself (Dooley, 1999). Training in this system is typically designed for survival as opposed to change, and teachers persist in teaching the way they were taught (Dooley). The issue becomes one of changing school culture (Purkey & Smith, 1983). Additional factors negatively affecting change relate to: poor support, inadequate skills and knowledge, inadequate release time for planning and training, "information overload" or "burn out" due to the pace and uncertainty of the technological change or innovation, innovation incompatibility, poor communication among teachers and administrators, inadequate evaluation in terms of effectiveness, and weak instructional leadership (Dooley, 1999).

Poor leadership, with its adverse affects on change, has been attributed to uninformed decision makers and leaders. The Report of the National Association of State Boards of Education Study Group on E-Learning reveals "that many decision makers [education leaders] do not fully understand the core challenges raised by e-learning" (NASBE, 2001, p. 8), and hence deter the adoption of policies that could facilitate instructional technologies and achievement: "the reality is that education leaders are not currently driving the policy agenda. Rapidly moving trends are outpacing the ability of policymakers to keep up" (p. 4).

Factors within technology often drive change within an organization. In the case of electronic technologies, the factors driving change include: the anywhere, anytime open access to the Internet, the power of interactive communication technologies such as e-learning, the limited capacity of textbooks and current curricula to accommodate expanding knowledge bases, the necessity for "knowledge workers" where "work involves learning", the emergence of, and

opportunities for, learning at home, and the recognition from students of powerful instructional resources outside of school (NASBE, 2001, p. 9). Kaplan and Godwin (2004) contend that technology has transformed the organizational environment and is also transforming the field of organizational development through interventions that use technology to facilitate "whole system collaboration and organizational change" (¶ 3). It is important to see "technology as an integrated component of the strategic change process…[tapping] the collective wisdom of the organization (Kaplan and Godwin, 2004, ¶ 9). Technology provides new opportunities for collaboration and three dominate applications in organizational development: 1) quantitative, data-based assessment tools, such as employee surveys and 360-degree feedback, 2) communications and teamwork, including document management and information sharing, and 3) management and employee development, including online training (Kaplan and Godwin, 2004, ¶ 2). The Report of the Web-based Education Commission (Kerrey et al., 2000) also reveals a transformation of the traditional classroom as a result of Internet technologies, a need for continuous training, and the positive benefits of the Internet for learning as factors driving change.

Models for Change

As means of understanding change, several models have evolved over the years. Among these interrelated models are Rogers' Diffusion of Innovations (DOI) theory, the concerns-based adoption model (CBAM) of Hall and Hord (1987), Zaltman and Duncan's (1977) Strategies for Planned Change, Ely's (1990) conditions for change, and systemic change (Reigeluth & Garfinkle, 1994). Ellsworth (2000) contends that the "classical change models" are still relevant to change agents today and that it is important to maintain a holistic view of change whether one's model for analysis or focus is of stages of change, or conditions that foster or inhibit change regardless of context. Ely's (1990; 1999) framework is similarly based on a holistic view of change in its attention to the environment, context and innovation, and acknowledgment of the interdependence of each condition.

Attention to a holistic view is found in many examinations of change. With its attention to the environment, context and innovation, and acknowledgment of the interdependence of facilitating conditions, Ely's (1990; 1999) framework clearly is based on a holistic view of change. Casler et al. (2002) also suggest a broad perspective of change consisting of three primary components: materials, beliefs, and approaches necessary for technology infusion in institutions of education. Dooley (1999) proposes a holistic model for the diffusion of educational technologies in his study based upon a combination of contextual factors, innovation concerns, and one's stage of adoption within the innovation-decision process. Theoretical frameworks of Rogers (1995) and Hall and Hord (1987) provide the foundation for Dooley's model, in addition to literature related to facilitating factors within computer technology and telecommunications in education. Dooley proposes that diffusion is dependent upon facilitation efforts by change agents and leadership, but implementation and acceptance of the innovation occurs with workers (teachers) who ultimately affect use of the innovation that is facilitated through training and support.

Models and processes found to foster implementation and change in business resemble much of what has been revealed in education (Ensminger, Surry, Porter & Wright, 2004). A

meta-analysis of decades of diffusion research identified Rogers' DOI model as one of the most important in terms of scope (Ellsworth, 2000). Subsequent models have taken a closer look at components within DOI theory, while others have successfully discovered areas neglected or which have received little emphasis. DOI theory is clearly the foundation for many models. According to Rogers, "diffusion is not a single, all-encompassing theory. It is several theoretical perspectives that relate to the overall concept of diffusion; it is a meta-theory" (Yates, 2001, p. 2). Marcinkiewicz, Robinson, and Surry (2001) conclude that "there is no single, unified, universally accepted theory of adoption and diffusion" (p. 7). Because the delivery and tools of education are changing and research in instructional technology diffusion, adoption and change has become paramount, Diffusion of Innovation theory is worthy of more in-depth review.

Diffusion of Innovations Theory

As stated earlier in this chapter, one type of change is innovation (Rogers, 1995, p. 11). An innovation is defined as any idea or object that is perceived as new by an adopter (Rogers, 1995). Diffusion of Innovations (DOI) theory, as a conceptual framework, analyzes innovations by examining three areas of focus: (1) characteristics of adopters, (2) attributes of an innovation, and (3) the innovation-decision process. Many methodologies exist for studying diffusion and they are embedded within many disciplines, such as sociology, economics, anthropology, geography and education (Charlton et al., 1997). Similarly, the study of diffusion theory is important to the field of instructional technology (Surry and Farquhar, 1997). Because of its dominance among the approaches to studying this topic, Roger's Diffusion of Innovation Theory will be the primary theory discussed in the following sections of this chapter.

Adopter Categories and Characteristics

The first component of DOI theory involves adopter characteristics. Personal characteristics of adopters affect their perceptions of innovations and these perceptions affect decisions regarding adoption. Adopters may be categorized into one of five adopter categories: innovator, early adopter, early majority, late majority, and laggards (Rogers, 1995). Each group has different perceptions and attitudes toward technology that affect the rate of adoption, and the degree to which one is earlier or later in the overall adoption cycle is considered to reflect one's degree of innovativeness. Innovators are characterized as risk-takers, explorers, technically knowledgeable, self-sufficient, having access to resources, financially secure, promoting technology within the diffusion process, and interested in the technology itself (Jacobsen, 1998; Moore, 1999; Rogers, 1995). Early adopters are more likely to be upper class, educated, opinion and organizational leaders, local evangelists, respected role models, part of larger interpersonal networks, seeking different uses of the technology through re-purposing/re-invention efforts, and from larger social systems. As role models within the system, they are sought by change agents in the planning, design and implementation stages to facilitate adoption and implementation (Moore, 1999; Rogers, 1995). The early majority provides the link between opinion leaders and the average member in the system and may be viewed as pragmatic adopters. They see technology as a "productivity improvement" over the status quo and expect the innovation to be bug free and easily integrated within their current infrastructure (Moore, 1999). They do not want a disruptive technology and depend on references and observable results within their group to convince them to adopt. The late majority is characterized by pessimistic attitudes and

conservative and cautious behavior. They adopt due to social pressure from peers and at a point where the innovation has been standardized. Laggards are more skeptical and operate with a "prove it" mentality toward the innovation before adoption. They are suspicious of innovators, are often victims of economic restraints, and eventually adopt due to necessity.

Attributes of an Innovation

The second component of DOI theory deals with the attributes of an innovation. Potential adopters utilize five characteristics or attributes of an innovation to judge its value (Rogers, 1995). These attributes or characteristics are: 1) relative advantage (is it better), 2) compatibility (is it compatible with current operation procedures), 3) complexity (is it easy to use), 4) trialability (can it be experimented with and learned without disrupting current work habits), and 5) observability (are positive results visible by others who may adopt the innovation). Studies assessing these attributes in various settings, including computer-based training (Surry & Gustafson, 1994), computer-mediated communication (Gillispie, 1996), and email (Kim, 1995), have confirmed the importance of these innovation attributes.

Combinations of the above innovation attributes can be seen in recent instructional technology innovations. For example, protocols associated with the Internet and the World Wide Web promote compatibility. Standardization of the hypertext transfer protocol (http) in conjunction with web browsers contributed greatly to the diffusion of the Internet (Charlton, Gittings, Leng, Little, & Neilson, 1997; Crossman, 1997). Open standards for delivery free trainers from proprietary systems, specific hardware platforms and investments in manuals and CD-ROMs (Curtin, 1997). Such open standards have been applied to the development of course management systems (CMSs) in efforts to provide more flexibility in building Web pages for online courses (Young, 2001). As a result, the implementation of CMSs is facilitated. It is evident in this context that diffusion is accredited to innovation attributes consisting of: ease of use, relative advantage, trialability and observability accomplished primarily through standardization**.**

Innovation-Decision Process

The final component of DOI theory involves the innovation-decision process. Rogers (1995) describes the innovation-decision process as:

> The process through which an individual (or other decision-making unit) passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision (p. 163).

Rogers (1995) identifies 5 stages in the innovation-decision process and contends that there is tentative empirical evidence that these conceptual stages within the innovation-decision process do exist in practice as revealed in various studies.

The first stage of the innovation-decision process is *knowledge*. Individuals are either active or passive in their acquisition of knowledge or awareness about an innovation (Rogers, 1995). One passively becomes aware of an innovation through communication channels (e.g. advertisements), or actively through the identification of a need as a result of awareness, or

through a need that leads to innovation and ultimately motivation to adopt (Rogers, 1995). Rogers concludes that research does not clearly answer whether knowledge of a need precedes knowledge of an innovation or vice versa. This knowledge stage is an "information-seeking" stage according to Rogers (1995), and although the individual may be aware of the innovation, it must be perceived as relevant to move forward in the innovation-decision process.

The second stage of the innovation-decision process is the *persuasion stage*. Relevance is an important aspect of persuasion. A positive or negative attitude toward the innovation evolves during this stage through an assessment of the status quo and innovation. Individuals' assessment of innovation attributes such as relative advantage, compatibility, and ease of use is paramount (Rogers, 1995). Persuasion is most influential if received from colleagues and peers. Investigations related to persuasion reveal that a positive or favorable attitude toward an innovation does not necessarily generate adoption; failure to adopt can be attributed to poor communication channels, availability of the innovation, resources, support structures or low self-efficacy (Rogers, 1995).

The *decision stage* typically follows persuasion, and does not necessarily imply a stage of rejection or adoption of the innovation. Rogers (1995) points out that rejection of an innovation can occur at any stage, and the sequence of these first three stages may be different in some contexts or cultures; the decision stage can actually precede persuasion. Individuals experiment with the innovation in a trial period during this stage to more fully assess its usefulness and relative advantage.

The *implementation stage* is defined as the point "when an individual puts an innovation into use" (Rogers, 1995, 172). This stage, the focus of this study, will be discussed in greater detail later. This is a very active stage as individuals change their behavior as part of the effort of putting the innovation to use. Adopters are actively involved in information-seeking as problems surrounding access to and use of the innovation surface. As the innovation diffuses within the system, "re-invention" can occur as the innovation is adapted to meet the needs of the adopter group. Rogers notes that such problems are greater when the adopter is an organization versus an individual.

As the innovation is implemented, adopters seek reinforcement regarding their decision to adopt or reject the innovation in a *confirmation stage*. As the innovation is utilized, adopters seek confirmation of the benefits of using the innovation and that its use is having an effect toward meeting identified needs. Use of the innovation, if adopted, then becomes sustained, routine and an integral part of the organization.

Systems Theory

Although Diffusion of Innovation theory does much to explain the process of innovation and the roles played by participants in this process, it has difficulty explaining associations among innovations and other elements of society (McMaster et al, 1997; Law, 1991; Tatnall, 2001). For example, McMaster et al. (1997) state that diffusion theory incorrectly separates society and technology. Technology and humans, in their view, coexist and are not to be thought of as independent entities. Nothing is purely social or technical (Law, 1991). The notion of

heterogeneous entities within a system and the processes of diffusion/adoption suggests analysis be based on the strength of associations within a socio-technical context (Tatnall, 2001). Rogers (1995) acknowledges the problems of assessing cause-effect relationships in diffusion analysis, and the difficulty in making generalizations when analyzing consequences of an innovation, as well as assessing the factors affecting adoption. A theory that addresses some of those issues is systems theory.

Systems theory suggests that technology and humans coexist as a unified whole, comprised of interrelated components (inputs, outputs and sub-systems) each interacting with and affecting one another (and the ultimate output or overall system goal of implementation); the removal of any one component would have an affect on the function of the entire system (Ellsworth, 1997; Ely, 1999; Rogers, 1995). Ellsworth (1997) has embraced systemic change as the new paradigm for successful implementation; one of interrelated changes (infrastructure, stakeholder involvement, methodology, and staff development) affecting the entire system, not one of individual changes. Ely (1978; 1990; 1999) also has approached the issue of implementation from this perspective of systems theory. His framework proposes, within a systems view, that implementation is not wholly dependent on any one condition, nor does any single condition exist in isolation; linkages with other conditions constitute a condition's existence and overall strength. For example, according to Ely, the condition, "availability of time" is linked with participation, commitment, leadership, and rewards and incentives. Consequently, the absence of any one condition reduces the effectiveness of the innovation and the implementation process. Furthermore, empirical investigations of a single condition or factor in implementation are difficult due to the interrelationships (Bauder, 1993; Ravitz, 1999).

Ely's (1990) framework shares a systems design model in approach. This approach consists of thorough front-end analysis where the emphasis is placed on the environment, before entering the development phase (Plotnick, 1997). It is understood that the instructional system is complex and is designed to address the needs of an organization. Basing his assumptions on Gustafson and Branch's (1997) survey of instructional development models, Plotnick believes the systems approach encompasses a broader attempt at addressing issues related to designing, development, and evaluation when compared to other models. Systems theory provides a foundation for understanding the vast interrelationships within diffusion, in general, and, more specifically, within the implementation phase of diffusion. A review of implementation literature reveals that the stages and processes of implementation are interrelated in terms of organizational, cultural and socio-technical issues that surround them.

Implementation

Literature regarding implementation and integration of instructional technologies (IT) suggests that despite a sound infrastructure, including support and funding, implementation efforts are often ineffective (Burton & Danielson, 1999; Blair, McGraw, & Ross, 1999; Byrom et al., 2000; Crosby, MacArthur, & Wang, 2003; Cuban, 1999; Ely, 1990b, 1999; Harris, 1994, 1998; Jacobsen, 1998; Kerrey et al., 2000; Mereba, 2003; Molenda & Sullivan, 2000; Stuhlmann, 1994). Mereba (2003) states, "many institutions of higher education have not yet begun to grab hold of technology's promise to reduce costs and push learning to new frontiers" (p. 42). Despite the opportunities available for educators, there is skepticism about online

learning and many college professors do not incorporate it as part of their instructional strategy (Crosby, MacArthur & Wang, 2003). Effective implementation of online learning technologies may depend on adopter perceptions of the merit of these technologies and its fit into the culture and practices of the organization (Myers, Bennett, Brown & Henderson, 2004).

Theoretical Justifications

Rogers' (1995) diffusion of innovations theory provides much of the theoretical basis for the study of implementation. For decades it has been and still is the model for assessing the adoption of a variety of technological innovations (Bhatt, Pendharkar, & Rodger, 1995; Buttolph, 1992; Carter, 1998; Johnson, Gatz, & Hicks, 1997; Dekimpe, Parker, & Sarvary, 1997; Flynn-Mcguire, 1996; Forrest, 1993; Gillispie, 1996; Gilliman, 1998; Kim, 1995; Martinez-Brawley, 1995; Medlin, 2001; Schorger, 1997). The areas of research associated with adoption, implementation, systems theory, and facilitating conditions provide much insight into long-term retention and sustainability of innovations (Surry & Brennan, 1998).

The aim of most of Rogers' (1995) research was focused on the adoption phase of the diffusion of innovations model. Rogers places little attention on implementation, and the literature shows that little has been done to assess users' transition from adoption to implementation and issues surrounding implementation. Much of the past research has focused on the conditions and actions prior to adoption, despite the existence of implementation in instructional development models centered on computer-based learning (Ely, 1999). Rogers (1995) recognizes this discrepancy by stating that diffusion researchers have focused more on adoption, "the decision to make full use of an innovation" (p. 21), as opposed to implementation.

As a framework or model for investigation, Ely's (1990) is one of a few instructional technology diffusion theories that attempts to address innovations at the implementation phase (Surry, Robinson, & Marcinkiewicz, 2001) and is seen as a plausible framework for further studying new and changing technologies (Ravitz, 1999). It addresses the change process from the perspective of organizational developers, educational planners, and change agents as attention is shifted away from the innovation to the environment as a facilitating factor in implementation (Ely, 1990b; 2002). The environment today is increasingly technological and presents an entirely different context for studying Ely's conditions compared to his initial study during the 1970s and during the 1980s.

The literature suggests that communication technologies may be best analyzed in terms of implementation and use as opposed to the adoption-decision processes (Rogers, 1995). Abbott and Yarbrough (1999) propose that an innovation such as computer-related technologies are multifaceted in terms of possible applications and use and state that "questions about <u>how</u> to use or apply them become more salient after adoption" (p. 44). Ely (1999) states that "implementation" is the "in" word and now is the time to focus on this phase of the change process:

> where innovations have been adopted and implemented, what were the conditions that appeared to facilitate the process? Are there consistencies among the facilitating conditions from innovation to innovation and from place to place? This reverse logic

> reverses a concern for resistance to one of facilitating factors—an avenue for further exploration…to tease out reasons for successful efforts (p. 3)

Ely (1990) proposes a need to study the influence of setting and innovation on the existence and strength of conditions that facilitate implementation. He notes that an inventory of these conditions and their strength may serve as an indicator of areas for improvement or potential problems in implementation. He cautions that these conditions cannot be determining factors in the exact causes or cures of all problems in actual cases due to the affects of culture, setting, adopter and innovation attributes on the efficacy of the conditions. He states: "Innovations are situation specific…the full power of the change models and the generalizations from the research can only be demonstrated when they are superimposed on actual cases" (Ely, 1976, p. 153). Ely and Surry (1999) conclude that there is no magic formula for identifying problems in implementation. Supporting Ely's contention, the following literature suggests that the user of an innovation should be a primary source for assessing concerns and problems in implementation.

Adopters as Key Stakeholders

As a subject for analysis, Ravitz (1999) states that teachers who are using the technology provide a sound source for studying these conditions once an infrastructure is established. Teachers who are resistant, or are not using the innovation, are a better source for pre-adoption studies. Controlling for grade level, subject matter, context, teaching philosophy, number of years teaching, teacher's experience with technology, and training received are considered to be important variables for analysis (Becker & Ravitz, 1998). Investigating correlations between subject matter taught and perspectives towards online instruction are considered to be beneficial research towards understanding attitudes of teachers (Crosby, MacArthur, & Wang, 2003). By investigating users who are familiar with the potential of an innovation, one controls for user experience level (Ravitz, 1999) and avoids, to some degree, many other variables associated with misinformed perspectives and preferences associated with users who may be unknowledgeable and inexperienced with the innovation (Lewis & Onton, 2000), as well the affect of knowledge and skill on concerns about the innovation (Hall, George & Rutherhord, 1998).

Cuban (1999) believes that teachers are seldom consulted concerning their perspectives and opinions on technologies. He contends that policymakers often overlook teachers' classroom needs. As a result, teachers are often unreceptive toward expert and administrative recommendations, making implementation, through a non-collaborative approach, difficult. Faculty are the adopters, adult learners and users of innovative technologies in this context, and are believed to be a powerful source for assessing implementation (Buttolph, 1992; Carr-Chellman & Whetstone, 2002; Rogers, 1995). Ensminger, Surry and Miller (2002) conclude that faculty are important stakeholders particularly when the innovation will directly affect them. Rogers sees users' actions on an innovation in terms of adapting, re-purposing, and re-inventing as essential to understanding the implementation stage. Buttolph (1992) also sees the individual user as an important factor: "there is consensus that adoption refers to changes made in an innovation to suit individual needs" (p. 462).

The user in this context is not only the adult learner and educator but also the stakeholder and participant in a collaborative process involving planning, designing, implementation, evaluation, and accountability. From this perspective, Boone (1992) notes that in professional renewal programs, the adult learner is the ultimate decision maker in terms of deciding whether or not to participate in a change process. Boone states that involving adult learners in "identifying and analyzing their own educational needs" is important in successful program development and change (p. 118). Dooley (1999), and Dooley, Martinez & Metcalf (1999) concur that the diffusion of IT in schools is affected by the concerns of teachers and administrators. Implementation is facilitated by the context and support from administrators, among other factors; however, "it's the teachers who implement the innovation …and impact the use of technology in the classroom" (Dooley, 1999). Backhouse (2003) states that Information and Communication Technology (ICT) in education can make a difference in teaching and learning if conditions are created and resources developed that focus on the needs of practicing teachers, and the "reasons and excuses, real or imagined, for slower adoption of ICT" (p. 5).

Innovation and Context

Ely's (1999) conditions have been traditionally studied in a context where the innovation has been actually implemented and used (as his framework stipulates), as opposed to investigations of planned or anticipated use. However, Ensminger (2001) proposes that these conditions can also serve more as a proactive approach toward product implementation through an assessment of these conditions at various stages of the design process. It becomes a practical approach for planning implementation efforts: "by addressing these factors during the adoption phase and development phase universities' increase their chances of successfully implementing an online learning program" (Ensminger & Surry, 2002, p. 3).

Technical support is part of the overall infrastructures in organizations, and this strong network of support is considered to be a prominent factor for successful IT integration (Surry & Land, 2001). However, in general, despite support and well-developed infrastructures, effective and widespread use of IT among faculty in educational systems is often sparse (Burton and Danielson, 1999; Cuba, 1999; Blair, McGraw, & Ross, 1999; Medlin, 2001; Molenda & Sullivan, 2000; Stuhlman, 1994).

The advent of software applications for information management such as course management systems (CMSs) have been implemented with relatively widespread use in education, specifically, its use as a tool for providing online course content (syllabi, data exchange, etc.). CMSs are seen as an efficient means for increasing faculty classroom time and enhancing teaching and learning. The time normally taken in class to distribute or present information, data or resources can be eliminated by using a CMS to disseminate this information thereby providing more class time (Cohn & Stoehr, 2000). Time, a prominent link among Ely's other conditions, is believed to be a major facilitating condition toward implementation of IT (Burton & Danielson, 1999; Ely, 1999), and may be highly correlated with use; it may also function as an incentive in this context for continued use. Within educational systems, a surge in interest in CMSs at the institutional level has been expressed by Stephen Ehrmann (2001) as part of his Flashlight project, a project that strives to foster educational use of technologies. Presently, Ehrmann notes that CMS studies are in fact limited, and his organization is currently

seeking case studies, and related studies investigating issues such as factors affecting use. As educational institutions have adopted CMSs, business and industry have adopted similar tools in an effort to increase and manage productivity.

Much research has been conducted regarding the early stages of diffusion. However, examination of the implementation phase is a relatively recent phenomenon. For example, although Rogers (1995) includes implementation in his later work, his earlier model of the innovation-decision process did not include implementation (Rogers & Shoemaker, 1971). Rogers (1995) explains "the importance of the implementation stage for individual/optional innovation-decisions" (p. 173) was not revealed until diffusion scholars began to study the innovation-decision process in organizations during the 1980s and early 1990s. The increased interest was attributed to a growing concern among business scholars about the innovation process and the explosion of computer-related technologies within a variety of organizations. These technologies often failed, and, as a result, stimulated an interest in how best to implement them.

Implementation is defined by Fullan (1996) as, "the actual use of an innovation in practice" (p. 3); "the process of putting into practice an idea, program, or set of activities new to the people attempting or expected to change" (Fullan, 1982, p. 54), "the process of introducing an innovation into an organization and fostering its use" (Enmsinger, Surry, Porter & Wright, 2004). Rogers (1995) similarly defines implementation as occurring when "an individual puts an innovation to use…[which] involves overt behavior change" (pp. 172-173).

Implementation should be distinguished from initiation (Rogers, 1995). Initiation consists of two stages: 1) "Agenda setting" is identifying problems within an organization that present a need for the innovation (as opposed to the reverse), and 2) "matching" a particular need to an innovation that will resolve an identified problem. In Roger's model, implementation has three stages, 1) "redefining/restructuring" processes involving innovation adaptation and re-invention leading to, 2) "clarifying" or confirmation of the innovation's utility in relation to organizational needs, and 3) "routinizing" whereby the innovation is ultimately institutionalized within the organization. Zaltman and Duncan (1977) identify two similar phases of implementation describing step one as a short-term trial period of experimentation followed by routinizing in step two. These three stages in implementation, and other components within implementation will be addressed as the focus of this study.

Redefining and Restructuring

Redefining and restructuring involve adaptation and re-invention. Re-invention is defined as "the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation" (Rogers, 1995, p. 174). Ely (1990) defines it as adaptation of the innovation to the norms of the environment or culture. Re-invention is also the result of adopter perceptions/perspectives, and socio-cultural values and beliefs applied to the innovation to fulfill needs and resolve compatibility issues which in turn promotes "sustainability" of the innovation, making it the user's "own", and encourages self-reliance. Although re-invention is the first step in implementation and a necessity for successful integration and continued use, resistance is common (Rogers, 1995).

Rogers cites six reasons for the occurrence of re-invention: 1) need for simplification/compatibility, 2) lack of knowledge/poor learning, 3) flexibility in applications, 4) modification to solve a wide range of problems other than its proposed solution, 5) need for ownership/local product, and 6) encouragement by change agents who implemented the innovation. While typically associated with the implementation phase, an innovation may undergo re-invention during the adoption phase prior to implementation (Buttolph, 1992).

Clarifying

Clarification defines how the innovation becomes part of the organization. Adopters, who are potential implementers, begin evaluating any problems and consequences of the innovation, and seek more knowledge about the innovation through communication, collaboration and interaction among those in the organization. Research shows that the culture of the organization can have an affect on such interaction. The culture of every organization is different, and these socio-cultural issues can affect implementation (Rogers, 1995). More centralized processes in corporations facilitate progress through stages of implementation; decentralized and complex organizations lead to slow decision-making processes and progress (Green & Gilbert, 1995; cited in Carter, 1998). According to Karl Weick, a renowned organizational theorist, school systems are "loosely coupled" (compared to "tightly coupled" systems in business); such systems have difficulty in sharing information, particularly among members along the same authority levels (Ehrmann, 2001). In a study of the diffusion of telecommunication networks across 160 countries, Dekimpe, Parker, and Sarvary (1997) found that heterogeneous social-systems experience slow implementation, but a higher income and more homogeneous social system were found to foster diffusion.

Routinizing

The end of the implementation stage, routinizing, is believed to occur when the innovation becomes institutionalized or routine within the organization; in other words, its removal would have an adverse affect on daily operations within the organization. Hartman and Truman-Davis (2001) see the process of institutionalism as being accomplished through: accepted instructional models, standards and conventions, faculty development, production support, infrastructure, incentives and rewards, and assessment.

Conditions Affecting Implementation

Conditions facilitating change identified earlier equally affect implementation. Implementation is a change in activities perceived as new to people or overt behavior change (Rogers, 1995; Fullan, 1982). Rogers (1995) sees implementation as a penultimate stage in the adoption and diffusion. Innovation or adoption infers some type of change (Ely, 1978), and implementation has been an assumed part of that process (Ely, 1990b; 1999). Implementation may be viewed from a positive or negative perspective. A positive perspective seeks to identify conditions fostering implementation; these conditions are the reverse of barriers. A negative perspective identifies these barriers to implementation. Ely (1990; 1999) takes the former approach and it is this approach that is the focus of this study.

Recurring themes in the literature regarding successful technology implementation are critical mass, collaboration, and the importance of planning. Critical mass is "the point at which enough individuals have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining" (Rogers, 1995, p. 313); Harris (1994) describes it as a community of users within an infrastructure of networks, support and resources. The interactive nature of communication technologies and interdependence such technologies create among adopters requires a critical mass to fuel adoption and implementation (Rogers, 1995). These innovations allow for and encourage re-invention or redefining/restructuring the use and purpose of the innovation due to its inherent variety in application and delivery modes. This re-invention process is an essential stage of implementation.

The themes of collaboration and planning are evident in many contexts assessed in the literature: school districts in California (Cradler, 2000); Temple University (Snelbecker et al., 2001); technology integration among faculty (Dove and Fisher, 1999); adult program development (Boone, 1992); and community educational technology initiatives (Sherry et al., 2000). Planning is the initial stage of any development and change process. A planned approach addresses funding, resources (human, physical, and fiscal), compatibility issues, user perceptions, student/staff/program needs, support, time, reward systems, integration issues, concise objectives, the innovation's link to organizational activities, staff development and evaluation and assessment strategies (Cradler, 2000; Snelbecker et al, 2001). Collaboration, which begins in the planning stage, is exemplified through shared leadership, vision, value, philosophy, commitment, and team efforts (Baek, Lee, & Spinner, 2002; Boone, 1992; Dove & Fisher, 1999; Luck, 2001).

Research assessing barriers to innovations reside in technical, financial and social uncertainty (Rogers, 1995). Leggett and Persichitte (1998) note that barriers and obstacles that have prevailed over the past fifty years continue to slow the implementation of current instructional technology. Based on their review of the literature, from both a historical and practitioner perspective, they identify barriers consistent with Ely's facilitating conditions (1990; 1999). Difficulty of use, lack of broadband access (Neubarth, 1997) and high cost concerns (Lewis, Alexander, Farris and Greene, 1997) also dominate much of the literature concerning technological innovations. Schorger (1997) identifies many of these problems within the context of computer-mediated communication (CMC).

Schorger (1997) examined CMC and described the implementation of the Blacksburg Electronic Village (BEV). BEV was an effort to bring CMC, local and global Internet electronic resources, to the community of Blacksburg, Virginia through the joint efforts of Bell Atlantic of Virginia, The Town of Blacksburg, and Virginia Tech. Early problems in implementation were identified as: poor user support, lack of availability and access to technology, difficulty of use in terms of software applications, training, marketing and communication channels, which failed to inform potential adopters of its existence, and high cost. Marketing is often overlooked as an important facilitator in implementation for "gaining acceptance of, consensus upon, or participation in any given educational venture…'selling' the program to community leaders and recruiting learners" (Boone, 1992, p. 157). It appears that if the designer or change agent is not involved in the actual implementation of the product, he/she must address marketing issues during planning, development and design.

Troxel (1994) notes that failure of instructional technologies, as they have been historically promulgated, can be attributed to the burden that is placed on the teachers to implement and change their traditional approach to instruction. Without skills and control over the media, teachers blocked these technologies in order to regain control in their classrooms. He cites a Rockefeller Foundation study on educational film (Saettler, 1990) that attributed failure to, among other things, poor administrative support and planning, and poorly trained teachers. Troxel states that, according to Hord, Rutherford, Huling-Austin, and Hall (1987), "change agents who introduced these technological innovations failed to account for at least two principles of innovation adoption: change is not an event – it is a process; and change has to happen within individuals" (p. 9). Ely (1995; cited in Carter, 1998) attributes failure to the fact that new technologies are often simply supplements to other resources and are seldom integrated into teaching and learning methodologies, or required to be utilized by teachers.

Implementation Research

Although discussions of diffusion often mention implementation, diffusion research has failed to effectively address the implementation stage in the diffusion process (Ely, 1999). Ely (1999) notes that implementation has been an assumed process, citing early works of Rogers (1962; Rogers & Shoemaker, 1971) and Hall's Concerns-Based Adoption Model (Hall & Hord, 1987) as addressing important precursory issues of implementation without specifically speaking to implementation. Ely (1978; 1990; 1999) recommends a systems view of the implementation stage, focusing on a set of environmental conditions believed to facilitate these change processes within implementation and as a means to better understand issues relating to the implementation of instructional technologies. These environmental conditions would be exposed through a reverse engineering process whereby conditions are assessed within a context where an innovation has been implemented as opposed to assessing factors of resistance embedded in the initiation and pre-adoption stages of contexts where an innovation has yet to be utilized.

Ely's Conditions

Donald P. Ely began his investigation of conditions for technological change in 1975. He was encouraged to pursue further research as a result of a well-received article (Ely, 1976) on conditions believed to facilitate and explain successful implementation of technologies in libraries (Ely, 1999). Through his review of the literature, Ely found that the conditions (leadership, dissatisfaction with the status quo, incentives and rewards, participation, support, time, commitment, skills and knowledge) were among those believed to predominate and facilitate implementation in a variety of contexts. During 1989, Ely's review of cross-cultural applications of the framework revealed the existence of these conditions in different cultures and suggested that the presence of the conditions may be generalized to other settings (Ely, 1999). Ely's findings were published in 1990 (Ely, 1990a). Although Ely's research has been well received, some research suggests that generalizing technology transfer among developing nations is difficult due to differences in stages of development, culture, environment, and variations in demands for education and training (Deif-Ayoub, 1997).

Ely (1999) contends that his "eight conditions are present in varying degrees when studied in terms of successful implementations of innovative programs and products" (p. 8).

However, he proposes, "what is not clear is the role of the setting in which the innovation is implemented…and nature of the innovation…[these] are major factors influencing the degree to which each condition is present" (p. 8). Although Ely contends that his framework focuses on the environment, it is clear that he recognizes innovation attributes as factors. These views reflect what Rogers (1995) has found in decades of research on diffusion and adoption: it is an issue of attributes and characteristics of the adopter within an established social system or culture ("the setting"), and attributes of the innovation ("the nature of the innovation").

Ely's conceptual conditions are embedded within Rogers' (1995) theory of diffusion processes in several aspects, as well as in Ehrmann's (2001) strategies for addressing a cycle of failure in instructional technology implementation and integration. An attempt is made here to reveal the associations, in theory and research where possible, as each condition is defined according to Ely (1999). These are presented in no particular order. Links to other conditions are cited, which implies that, without the linkage, implementation can be hindered and that particular condition is considered a barrier.

Dissatisfaction with the Status Quo

This condition is concerned with feelings of dissatisfaction with current conditions and expressed needs for improvement (innate or induced). It exists in a mix of conditions, and is linked to leadership (Ely, 1999). Dissatisfaction with the status quo can be analyzed in terms of one's perceptions of Rogers' (1995) innovation attributes: the relative advantage, compatibility, and complexity of the innovation. A disruption of the status quo would infer an attention gaining innovation whether observable results and benefits exist or not. Barriers consist of one's resistance to change, poor collaboration, lack of stakeholder support, and poor motivation, or satisfaction with current, and possibly insufficient methods.

There appear to be other linkages with other conditions concerning the status quo. If adopters are satisfied with the way things are, then the innovation will consequently appear as a disruptive technology as defined by Christenson (1999) and of little value. As a result, leadership, commitment, participation, resources and support are all difficult to obtain, especially when it requires a change in the organization's culture and stakeholder behavior (Christenson, 1999; Moore, 1998). Smooth transitions from the status quo can be obtained by understanding and adapting to the socio-technical culture and philosophy of the organization (Boone, 1992; McMaster, 1997; Tatnall, 2001); encouraging collaboration and communication with key stakeholders/leaders; establishing and addressing goals and objectives of the users; identifying the context and setting; addressing motivation and change through relevance (Wlodkowski, 1993); and conducting formative/summative evaluations to ensure that planned change is on target and addressing felt needs.

Existence of Knowledge and Skills

The concern here is of skills or competence required by the end user of the innovation. Linkages are resources, rewards and incentives, leadership, and commitment. Barriers are attributed to poor needs analysis, weak goals/objectives, poor instructional design and methodologies, system culture, philosophy, adopter perceptions, attitudes, fear, and relevance.

Also poor self-efficacy, poor user motivation and unperceived success are hindrances (Ensmginer, 2001).

The attainment of knowledge and skills is the result of proper needs analysis (Dick & Carey, 1996), and obtainable objectives (Boone, 1992; Keller, 1983; Woldkowski, 1985). A sense of success while learning new skills builds confidence, satisfaction and an intrinsic desire to learn (Keller, 1983). Rogers (1995) innovation attributes of trailability and innovation complexity come into play also as skills are assessed from these perspectives of the innovation.

As part of the planning process, required knowledge is a collaborative effort among all affected in the change process upon which a clear concise goal must be identified, and a hierarchy of needs and objectives are defined (Boone, 1992). These objectives not only guide the development of skills but also improve communication between the change agent/instructor and learner by providing clear descriptions of what is required for implementation. Interrelationships between the designer, key stakeholders, and learner become evident as one looks at the issue of collaboration and communication in goal and needs analysis. Roger's (1995) has identified the importance of communication channels in facilitating adoption, and this collaborative process infers commitment and participation among stakeholders toward developing and achieving objectives that will produce desired knowledge and skills.

A perceived lack of adequate technology skills among teachers is prevalent. According to Kerrey et al (2000), almost two-thirds of all K-12 teachers feel they are not at all prepared or only somewhat prepared to use technology in their teaching, and 65% have never used a computer before being introduced to one in the classroom (p. 39). They assert that teachers must be comfortable with technology, its applications, and be knowledgeable with new technological tools, resources, and approaches to affect the degree to which students learn from technological innovations such as the Internet.

Molenda and Sullivan (2000) assessed current issues and trends in instructional technology and found that the majority of teachers continue to instruct within the familiar fundamental process of teaching and learning methodologies despite the fact that more teachers and students use computers for research, preparation and presentation. Molenda and Sullivan find that prominent barriers in the growth of instructional technology among all sectors are "deficiencies in upgrading the technology skills of existing teaching staff" (p. 12).

Satisfaction and confidence, important in Keller's (1983) ARCS model for motivation, will decrease among users without experienced technical support and the proper skills needed to gain confidence. Confidence can also be derailed by intimidation (Forrest, 1993; Spicer; 1952), and poor self-efficacy (Cloutier, 2001).

Diffusion is more complex when it involves adults, as "technology intimidation" and time demands affect training in the use of new technologies by educators and administrators (Forrest, 1993). In an investigation of the diffusion processes of information technology within a small, rural high school setting, Forrest (1993) estimated that 70-90% of the faculty support time is focused on maintenance and trouble shooting hardware and software. Forrest (1993) proposes

that increased support staff may be needed in part due to the variety of areas in technology demanding a certain degree of expertise.

Many resources exist to support the acquisition of skills, such as in-service courses, self-instructional programs, tutorial assistance, formal education, and more commonly, faculty development programs and workshops. Addressing learning barriers can ensure competency. These barriers include poor memory, lack of motivation and reinforcement, negative attitudes, and a failure to address learner needs and the environment/atmosphere (Brookfield, 1986; Knowles, 1990; Merriam and Caffarella, 1991). Objectives must be obtainable and measurable, and training should be a confidence-building element (Ensminger, 2001).

Availability of Resources

Resources are anything that is required for implementation of the innovation, including hardware, software, supplies, funding, technical support, and teaching materials. Linkages are commitment, leadership, and rewards and incentives. Economics, lack of funding (Ellsworth, 1997), poor infrastructure (Barone & Hanger, 2001; Berge & Muinlenburg, 2001; Boettcher et al., 2001; Burton & Danielson, 1999; Carman, 1999; Carter, 1998; Charlton et al., 1997; Ellsworth, 1997; Ely, 1990b; Harris, 1994; Hartman & Truman-Davis, 2001; Head & Moore, 1999; Katz, 2002; Noblitt, 1997; Stuhlman, 1997), inadequate access to equipment (Leggett and Persichitte, 1998; NASBE, 2001; Rogers, 1995; Stuhlmann, 1994), and a concern for a return on investment (Ensminger, 2001) are clear barriers to the acquisition of resources.

Strategies for confronting these issues include establishing a network of alliances to ensure funding and support (Tatnall, 2001), as well as providing access to the resources from libraries, home, office, and schools. Providing return on investment models can also encourage investment of resources and commitment (Ensminger, 2001). Mereba (2003) contends that the allocation of funds for resources can be misguided if not clearly connected with the institution's core mission, goals and objectives.

Availability of Time

Ely (1999) defines time as company time, as well as some personal time needed to acquire skills/knowledge, plan, adapt, "re-invent" (Rogers, 1995), reflect, and integrate the innovation. Backhouse (2003) notes that time management is "a challenge that educators face on a daily basis" (p. 5). Teachers are in a constant state of assessing the many demands of, and the best use of their time. Backhouse identifies the demands of time as time for planning, preparing classroom materials, professional learning, record keeping, assessment, reporting, collaboration with peers, developing instruction, participating in extracurricular activities, and teaching. Backhouse contends that faculty are often reluctant to adopt Information and Communication Technology (ICT) that are perceived to be yet another demand of their time. However, savings in time may simply be latent; Mereba (2003) notes that technology can promote learning productivity as well as learning.

Rogers' innovation attribute "trialibility" is also expressed as an issue of time: time to experiment with the technology, which requires a commitment to achieve results. Linkages are

participation, commitment, leadership and rewards and incentives. Time may also be considered a resource. Barriers reside in faculty/administrator commitments, heavy course loads, and research obligations. Several studies have found time to be a strong condition.

Burton and Danielson (1999) investigated general implementation of instructional technologies at Virginia Polytechnic Institute and State University in Blacksburg, Virginia through a survey, interviews and focus groups of faculty within the College of Education. Using Ely's (1990; 1999) framework, their study suggests that despite a well-established infrastructure and support, ample time for teachers to implement was found to be a missing piece toward successful implementation. Crosby, MacArthur and Wang's (2003) survey of community college professor's attitude towards online learning revealed that faculty believe that online courses may not be worth the effort due to the increased time it takes to design them.

Cuban (1999), reporting his research from a high school perspective, found time to be an important factor in addition to support and participation. Cuban states that 7 of 10 American teachers use computers for school, business, and personal related matters in their home more than at school. He contends that factors such as time and teacher opinions may provide a means for exploration into solving this puzzle of limited classroom use.

Time is undisputed in the literature as a necessity for users to experiment, learn, and adapt the technology. However, as Rogers (1995) suggests, the condition of time extends beyond the time required for users to acquire skills. Stage two of Green and Gilbert's (1995; cited in Carter, 1998) implementation process suggests that many years may be required for an organization to address major increases in staffing and operating expenses in order to support and fund a new technology. Also, as learners gain expertise with the innovation, the complexity of use increases and so does the need for more experienced support staff (Burton & Danielson, 1999). Without careful planning, and a more broad view of the condition of time, innovations can lose the commitment and leadership from key stakeholders.

Daniels and Starken-Meyerring (1999) state that change agencies allocate little time for re-invention issues and are sometimes fearful of re-invention due to the possibility that the innovation may develop into one that may challenge funding purposes and spending among funding agencies. They stress that re-invention is important in diffusion stating that "users need to be active decision-makers, adjusting the innovation to their cultural and economic context rather than passively implementing the innovation" (p. 6). These adjustments require time. Furthermore, they find that feedback on re-inventive efforts and extensive knowledge of the innovation assists in moving the innovation toward its full potential. This feedback can be from support staff through their assistance in "re-purposing" or adapting course material for online educational purposes (Burton and Danielson, 1999). However, regardless of the source, feedback requires time.

Strategies addressing time reside in modules and activities that can be developed for re-use (Harris, 1994). Such an initiative has begun through Advanced Distributed Learning's (ADL) Sharable Content Object Reference Model (SCORM). Other strategies include providing paid time to develop skills, which also displays evidence of leadership's commitment (Ensminger, 2001). Support staff can also expedite course development and problem solving,

provided adequate specialized services exist to meet growing technical needs as users advance (Burton & Danielson, 1999).

Existence of Rewards or Incentives

Intrinsic rewards are known to be most effective, but difficult to measure. More tangible examples or rewards have been described as bonuses, release time, and recognition. Linkages are participation, resources, time, and dissatisfaction with the status quo. A barrier to an incentive resides in one's failure to see an impact on teaching/learning, or perceived need. The associations with the status quo have been addressed, and may be further analyzed in terms of innovation attributes. For example, if the innovation is not compatible or easy to use, there is no incentive to implement.

Strategies for developing incentives reside in allowing users to see successful implementation efforts ("observability"), outcomes, savings in time through automation ("relative advantage") and enabling access to resources (Rogers, 1995). Also, encouraging re-invention can foster a sense of "ownership", increased self-reliance and flexibility as an intrinsic reward (Harris, 1994); ensuring that financial incentives (bonuses), professional opportunities, and intrinsic rewards such as social praise, achievement certificates are a product of implementation (Ely, 1990b); and providing personal computers, free Internet access, and course credit as extrinsic rewards. When considering incentives, Richard Clark, professor of educational psychology and technology at the Rossier School of Education, University of Southern California contends:

> financial incentives really work if they're used correctly...[rewarding people that exceed past performance]… people who believe that money or gift incentives destroy the motivation to work are wrong…that debate has been settled in the published research but hasn't made it into the wider world…social incentives, such as having employee-of-the-week programs, don't appear to make much of a difference in performance (Galagan, 2003, ¶ 2-3) .

If leaders are providing these experiences, it exemplifies their commitment (Ensminger, 2001), and if users value the task, they are more likely to engage in the task (Keller, 1983). Support from administration is a strong incentive; however, other incentives may need to be identified as faculty are not likely to see value in developing online content if the time required to develop it is extensive and the course is difficult to transform into an online format (Crosby, MacArthur, & Wang, 2003).

Participation

This condition is considered to be strong and consists of the following: shared decision-making; communication among all parties involved in the process, and when direct participation is not possible, the implementers should feel that their ideas are represented through a surrogate. Linkages are time, commitment, knowledge and skills, and rewards and incentives. Participation and commitment have been shown to be dependent upon the presence of incentives, particularly intrinsic rewards (Woldkowski, 1985), and relevance, confidence and satisfaction (Keller, 1983).

Barriers are attributed to poor communication channels and collaboration, a key process in Rogers' (1995) model.

Participation can be addressed by identifying and involving key stakeholders: administrators, teachers, support staff and anyone affected by the innovation through communication such as Teaching, Learning Round Tables (TLRT) (Ehrmann, 2001); establishing LISTSERVS; encouraging collaboration through group developed modules or applications that can be utilized in a variety of settings/contexts to facilitate continued use and interest (Harris, 1994).

Commitment

Commitment is usually measured by the perceptions of those implementing the innovation. The focus is on visible endorsement and continuing support and commitment toward implementation of the innovation from generally anyone involved and affected by the innovation such as supervisors, leaders, and key stakeholders. Linkages are leadership, resources, and rewards and incentives, and a strong linkage with time. Barriers are linked to poor communication, failure to identify and involve key stakeholders; failure to adopt the philosophy of the organization, needs of the users, and goals of the institution.

Commitment can be achieved through the establishment of TLRTs (Ehrmann, 2001) involving key stakeholders such as administrators, teachers, deans, and department heads in the process of implementation as a means of establishing and sustaining commitment and interest and by ensuring that commitment occurs at all levels (Ely, 1990b). Key leaders can encourage and work with users in implementation and involvement by providing time, rewards, incentives, feedback and encouragement (Ensminger, 2001).

Leadership

Ely (1990;1999) defines leadership in terms of support from project managers working closely with users, to executive officers providing financial support. Linkages are participation, commitment, time, resources, and rewards and incentives. Barriers exist in a failure to identify key stakeholders, poor communication and collaboration among all affected by the innovation, time, and failure to anticipate "chasms" between early adopters and the early majority.

Fullan defines leadership as "the capacity to engage in solving a complex problem" (personal interview, Cisek, 2002). Strategies for ensuring effective leadership consist of an establishment of a network of alliances (Tatnall, 2001). These alliances are among all individuals affected by the change process (Boone, 1992). Leadership exists within chairmen of departments, deans of schools, key leaders that may be identified as resource persons or early adopters that may serve as role models and opinion leaders for mainstream users within the department (Ehrmann, 2001). These leaders are identified through their knowledge of the application and its perceived uses and visions for future applications. Project leaders ensure training is relevant, materials are available, and make themselves available for encouragement and shared enthusiasm. Fullan (2002) states "leaders will increase their effectiveness if they continually work on the five components of leadership…pursue moral purpose, understand the

change process, develop relationships, foster knowledge building, and strive for coherence" (p.11).

It is evident that definitions of these eight conditions provided within the literature reveal the interrelationships between them, and, to a degree, how other terms or constructs used to express issues surrounding change and implementation are embedded within one of the eight as presented by Ely (1990; 1999). A summary of the interaction of Ely's (1990; 1999) conditions, as presented by Ensminger (2001), can be restated to reveal linkages as follows: *commitment* is a sign of *leadership* that fosters *participation* from all stakeholders and influences the *status quo*, which indicates a willingness from *leadership* to provide training (an issue of *time and support*), *resources, and incentives* which in turn encourages continued *participation*, increases user *skills/knowledge,* thereby improving self-efficacy and creating a sense of value for the product (p. 52-53). Because of the interrelatedness of Ely's conditions, Ensminger cautions designers not to focus on any one condition; doing so can affect the strength of another condition and ultimately the combined effect of all factors on implementation. The table below depicts the linkages, adopted from Ely's (1999) meta-analysis, of these conditions as follows: Dissatisfaction with Status Quo (SQ), Knowledge and Skills (KS), Resources (RS), Time (TM), Rewards and Incentive (RI), Participation (PT), Commitment (CM), and Leadership (LD). Direct linkages are read from left to right.

Table 1

Linkages of Ely's Conditions

SQ								**X**
KS			**X**		**X**		**X**	**X**
RS					**X**		**X**	**X**
TM					**X**	**X**	**X**	**X**
RI	**X**		**X**	**X**		**X**		
PT		**X**		**X**	**X**		**X**	
CM			**X**	**X**	**X**			
LD			**X**	**X**	**X**	**X**	**X**	
	SQ	**KS**	**RS**	**TM**	**RI**	**PT**	**CM**	**LD**

Research and Ely's Conditions

Ely (1999) has stated that there is some indication that trust may be an additional condition for successful implementation, however, according to Ely research at that time provided insufficient evidence. Ely (1999) suggested that attempts to uncover additional conditions were "conceptual synonyms" of one of the eight conditions (p. 8). In an attempt to address the construct trust, a review of the literature on trust on implementation of change was conducted and purported to support the notion of trust as a separate condition (Haab, Surry, Stout

& Hall, 2004). The authors agree that trust is related to the condition of leadership and possibly commitment, but not completely embedded in the construct leadership. Those involved in implementation and the change process must sense trust beyond those in leadership to change agents, instructional designers, managers, co-workers, and the innovation to be adopted (Haab, Surry, Stout & Hall, 2004). Boone (1992) has similarly stated that successful implementation is dependent upon collaboration and involvement from all affected by the process.

History has revealed many poorly implemented instructional technologies (IT) that have failed (Troxel, 1994). The proliferation of application software during the past few years has led scholars concerned with diffusion and implementation to reassess conditions that may affect adaptation and use (Ely, 1999; Ehrmann, 2001; D.W. Surry, personal communication, November, 2003). The literature also discloses a limited knowledgebase regarding conditions surrounding successful implementation with regard to IT, and specifically software applications. For example, among the studies cited by Ely (1999), none have addressed his conditions concerning specific web-based application software such as a course management system (CMS). CMSs have emerged over the past few years as an important tool for teachers and students (Ansorge & Cooley, 2001; Hopper, 2001) and research in this area is also limited (Ehrmann, 2001). "Changing times" may rewrite conditions identified within this framework (Ely, 1990b). Ely (1990; 1999) proposes that past change processes are not necessarily applicable to recent software innovations. Rogers (1995) concurs that software innovations are more likely to undergo reinvention and adaptation by users. As such, adopter perspectives become an important element in understanding implementation.

Results of recent studies with regard to specific web-based innovations reveal a need to consider intrinsic and extrinsic rewards as separate conditions; the condition of commitment be "measured by perceptions of activities rather than acknowledgement of policy" (Bauder, 1993, p. 97), whether incentives translate into use or incentives to participate; to acknowledge the various definitions of incentives in the literature; and a need for refining conceptualizations and operational definitions of these abstract concepts in order to validate measurements (Bauder, 1993). Bauder contends that motivation for using computers in instruction should be explored, noting that extrinsic incentives are shown to be insufficient motivators.

The setting for Ely's framework in recent Internet related studies has been broad in nature (Ensminger, Surry, & Miller, 2003; Ravitz, 1999). Such broad applications associated with web-based technologies may make perceptions and conceptualizations of use difficult to assess by users. Within investigations of user perceptions, little attention is given to the many factors affecting perception such as stage of implementation (Green & Gilbert, 1995; Sherry et al., 2001). The novelty of an innovation is believed to impede one's ability to explain preferences conceptually (Lewis & Orton, 2001), therefore, the subjects for analysis must possess a degree of expertise with the technology as a means for ensuring that user perceptions go beyond the surface features of the innovation (Bruer, 1994; Lewis & Orton, 2001; Ravitz, 1999; Sherry et al., 2000). Difficulty in conceptualizations of an innovation, particularly among novice users, can exist (Cloutier 2001; Dooley, 1999; Ravitz, 1999). Additionally, subjects should share similar experiences with regard to use (Askar & Usluel, 2001). Failure to attend to these considerations has confounded much of the research.

The investigation of perspectives can be problematic in terms of validity as some individuals can experience difficulty in understanding an innovation's potential and the need to adopt depending upon their stage of concern, use or awareness (Askar & Usluel, 2001; Hall & Hord, 1987). Perception of use can vary between individuals (Tatnall, 2001). For example, one individual may see a CMS as a means of communication and collaboration, while another may view it simply as a course web site.

Faculty are typically late majority adopters (Jacobsen, 1998). Such late adopters struggle to see the benefits and use of an innovation (Moore, 1999). Furthermore, one's stage in the implementation process, from learner to leader, novice to expert, may also be a factor (Sherry et al., 2000), as well as the maturity of the infrastructure as perceived barriers decrease (Berge & Muilenburg, 2001), and whether one is a high or low user of the technology (Dooley, 1999), or within an implementation stage of reinvention or institutionalization (Rogers, 1995).

The literature suggests that future research focus on issues surrounding implementation (Ely, 1990b; Ravitz, 1998; 1999, Rogers, 1995; D.W. Surry, personal communication, November, 2003; Ensminger, Surry, Porter and Wright, 2004) and that the adopter is a major source in change (Buttolph, 1992; Rogers, 1995), yet as a subject for analysis, faculty are believed to be an overlooked source in assessing implementation issues (Bober, 2002; Carr-Chellman & Whetstone, 2001; Cuban, 1999; Dooley, 1999; Dove & Fisher, 1999; Ely, 1990b). Faculty are typically viewed as late majority adopters. Such late adopters struggle to see the benefits and use of an innovation (Moore, 1999). Barone and Hagner (2001) contend that faculty entering the higher education profession now possess the technological skills for technology-based learning environments, and such environments improve the utility of teaching and learning as students have become accustomed to the accessibility of information. Consequently, Barone and Hanger (2001) see faculty as important stakeholders and propose "new governance conventions, designed to involve faculty strategically and viably in decision making" (p. 93-94).

The strength and importance of conditions found to be influential in successful implementation efforts are believed to be dependent upon the context and innovation (Ely, 1990b; 1999). Consequently, research is needed to validate conditions for successful implementation previously discovered in different settings, contexts, and innovations, with recent software and new issues emerging from new technologies and learning environments (Ely, 1990b; 1999). Generalizations regarding the importance of each have not been determined, and there is a suspicion that other conditions may have evolved with recent IT innovations.

General confirmation and acknowledgement of Ely's framework within recent research is evident in the adoption of new technologies in education (Danielson & Burton, 1999) and the adoption of computer-based technologies in higher education (Carter, 1998). Ely's framework has also been analyzed as an instructional design model where these conditions are evident not just during implementation but expressed as important issues throughout the design process (Ensminger, 2001). The importance of Ely's conditions can also be seen in a review of implementation and adoption studies where Ely's framework was not used as a basis for investigation. These include an investigation of computer technology integration within two North American universities (Jacobsen, 1998); distance education (Berge & Muilenburg, 2001); the implementation of informational technology in small businesses in Singapore (Thong & Yap,

1997); a study of faculty adoption behavior (Medlin, 2001); adoption of computers for delivering instruction among secondary-level public school business education teachers (Gbomita, 1997); and an assessment of technology integration in teaching (Byrom, 1998; Byrom et al. 2000).

Barone and Hanger (2001) uncovered "Twelve Campus Conditions for Transformation" from sessions of the National Learning Infrastructure Initiative (NLII) during the first half of 2000. These conditions are believed to encourage sustainability, support, and new student learning styles within distributed learning and provide a basis for informed and practical decision making. Although the authors did acknowledge Roger's (1995) research, the authors did not acknowledge Ely's conditions in their research. Upon investigating Barone and Hanger's conditions it becomes apparent that their conditions can be defined in terms of Ely's constructs, and consequently what was uncovered is consistent with both Roger's and as well as Ely's findings.

Although Ely's (1990) conditions have been confirmed in various dissertations on change and implementation (Ely, 1999), concentrated investigations of Ely's framework and the relative importance of Ely's conditions regarding modern technology over the past 15 years are limited to: computer integration in K-12 schools (Bauder, 1993); instructional television (Marovitz, 1994); Internet use in schools (Ravitz, 1999); pre-implementation adopter profiles of a hypothetical computer system (Ensminger, Surry, & Miller, 2003); and the implementation of online education programs (Ensminger, Surry, & Miller, 2003). These studies bring into question issues surrounding the assessment of the relative importance of Ely's conditions, context, methodology and the absence of investigations of Ely's framework with specific and more modern instructional technologies.

An investigation of the strength or relative importance of Ely's conditions has been approached by Bauder (1993). Bauder's study is more closely related to the context of this study in its investigation of a product innovation, the implementation of computers and software within elementary and secondary curricula. K-12 teachers (N=325) from twenty-five schools varying in setting, grade level, and governance type participated in the survey. Utilizing a forty-item questionnaire consisting of a six point Likert-type scale, five statements were created for each of the eight conditions resulting in a score of five to thirty for any single condition. Items were stated positively and negatively to control for response bias. Significant differences in perceptions of leadership, rewards and incentives, and time were found among teachers from suburban versus rural settings. Perceptions of conditions also varied among school level (elementary, middle, and high school) as well as public versus private. These differences in perspectives, as a result of context, are consistent with much of what is presented in the literature regarding perceptions.

Ravitz (1999) investigated the presence of Ely's conditions as they related to teachers' use of the Internet, personally and with students. Teachers (N=238) from 124 K-12 schools across the United States were surveyed during 1997. Ravtiz found considerable correlation between condition scores; however, dissatisfaction with the status quo had the least and was the only strong predictor of Internet use for teachers and students. In general, conditions were found to be better predictors of teacher "professional or exploratory use" versus student use. Ravitz questions the causality in terms of conceptualizations of the conditions. He proposes that

conditions may surface as outcomes of use while others may surface through a cyclical effect. For example, initial knowledge and skills required for use may lead to a need for greater skills; a contention also revealed by Burton and Danielson (1999). Ravitz purports that Ely's conditions may be better examined by measuring them prior to implementation as a means of facilitating the implementation process thereby ensuring that conditions believed to foster implementation are in place at the start of the process. Ravitz also proposes that the predictive validity of Ely's conditions may be assessed by employing them prior to implementation, then measuring progress toward implementation goals at a later time. This proactive assessment of Ely's conditions has been the approach to recent investigations of Ely's conditions (Ensminger, 2001; Ensminger, Miller & Surry, 2002).

Ensminger, Miller and Surry (2002) provide such a proactive investigation of the relative importance of Ely's conditions. They investigated faculty (N=56) perceptions of conditions that facilitate the implementation of online education programs. Participants varied in education level and, position (faculty and staff), and were from a mixture of contexts. 94% of the participants had experienced a facilitative role in the implementation of such programs. The study presented a series of scenario-based questions and non-scenario-based questions via an online survey to assess which conditions were most influential in the implementation of a fictitious new university online degree program and a new program or technology respectively. The study was based upon Ensminger's (2001) proactive approach to the employment and assessment of Ely's (1990) conditions during the design process as opposed to a post-implementation investigation. Issues such as variances in context and participant experience level appear to influence participant responses. However, no significant difference for any of the conditions existed between perceptions of faculty employed by four year or two-year institutions. Descriptive statistics indicated that three conditions, Resources, Skills/Knowledge, and Dissatisfaction with the Status Quo, were perceived as more important.

Table 2

Descriptive Statistics for Scenario Questions Presented by Mean Value

Condition	Mean	SD	Range
Resources	1.19	.58	1-4
Knowledge & Skills	1.25	.50	1-3
Status Quo	1.36	.49	1-3
Commitment	2.17	.77	1-4
Rewards	2.25	.77	1-4
Participation	2.31	.86	1-4
Leadership	2.39	.80	1-4
Time	2.56	.91	1-5

Note. From "Implementation of online education programs: Faculty perceptions of the conditions that facilitate implementation" by Ensminger, Surry, and Miller (2003).

Participants were also asked non-scenario questions regarding their perceptions of the relative importance of each condition in terms of implementing a new program or technology. Results of perceived relative importance of the conditions are presented below.

Table 3

Percentage of Faculty Who Perceive a Condition as Important to the Implementation Process: *Non-scenario questions*

Condition	Percent Perceiving it as Important
Resources	88.9
Participation	72.2
Rewards and Incentives	72.2
Skills and Knowledge	66.7
Commitment	61.1
Time	58.3
Leadership	39.9
Status Quo	36.1

Note. From "Implementation of online education programs: Faculty perceptions of the conditions that facilitate implementation" by Ensminger, Surry, and Miller (2003).

The authors note that although adequate Skills and Knowledge was also perceived as important, Dissatisfaction with the Status Quo was considered to be the least important, yet all respondents indicated that it was a strong influence on implementation in the scenario questions. The authors state that this finding is a counterintuitive result that requires further research. These results suggest that environmental factors, type of innovation and use, among other factors, may be influencing perspectives. Also, investigations with a larger sample size would appear valuable for further research. Furthermore, an actual and post-implementation investigation would provide more credence due to unanticipated or latent factors that can evolve in a program during and after deployment (Boone, 1992). Actual use can be multifaceted (Abbott & Yarbrough, 1999), and the presence of these conditions may be outcomes of use (Ravitz, 1999), in addition making generalizations across innovations, contexts, and populations can be questionable without further study, particularly within a real context. Predictability and credence could be further strengthened with greater attention to participant experience level with the innovation and technology, the degree of program implementation, and similarities that may be found to exist in terms of the importance of these conditions perceived prior to and after implementation, and/or between a hypothetical vs. actual scenarios, and between similar innovations.

Prior research has focused on the assessment of the eight conditions after implementation (Ensminger, Surry, Porter and Wright, 2004). Assessing adopter's perceptions of Ely's (1990; 1999) conditions prior to implementation can provide an adopter profile that can assist instructional designers in planning, design, development and particularly successful implementation (Ensminger, 2001; Ensminger, Surry, & Miller, 2002). Current research by Dan Surry and David Ensminger at iphase.org has employed this approach toward assessing Ely's

conditions and implementation. The Implementation Profile Instrument (IPI) was developed as part of the Implementation Phase Research Project (iphase.org) during 2002 for the measurement of these conditions from a proactive, pre-implementation versus post-implementation perspective for the purpose of assessing adopter profiles to better assist organizational change agents and instructional designers in process or product implementation efforts (Anderton, Amarasing, Ensminger, & Surry, 2003).

A recent study by Ensminger, Surry, Porter and Wright (2004) utilizing the IPI was conducted to determine the presence of any underlying relationships between Ely's eight conditions. The IPI, a 56-item online questionnaire, was designed to determine which conditions were perceived as more important when compared to the other conditions. Participants (N=179), from various fields ranging from education to industry, were asked to assess a hypothetical context and innovation. Factor analysis was conducted to determine underlying relationships between the conditions. Results revealed an underlying relationship between conditions in terms of four factors: 1) "Managed Change" where upper level management and direct supervisors are actively involved in leadership and communication during the implementation process explained 25.3% of the total variance; Leadership and Commitment loaded on this factor. 2) "Performance Efficacy" refers to the adopter's belief that they have or will be able to acquire the skills to use the innovation, and consequently see no need to participate in the change process. Explaining 19.8% of the total variance, Participation, Time and Skills & Knowledge loaded on this factor. 3) "External Rewards", refers to the adopter's belief that their participation is dependent upon some form of a reward for using the innovation. Explaining 14.2% of the total variance, Rewards was the only condition loaded on this factor. 4) "Resources", concerns for equipment, finances to personnel, and accessibility explain 14% of the total variance; Resources was the only condition loading on this factor. Descriptive analysis of the relative importance of conditions revealed the following:

Table 4

Means and Standard Deviations of Profiles Scores for Total Sample

Condition	N	Mean	Std. Deviation
Status Quo	179	7.24	4.26
Knowledge & Skills	179	7.98	3.70
Resources	179	8.39	2.98
Time	179	7.13	3.29
Participation	179	8.11	4.13
Rewards	179	7.36	3.76
Commitment	179	4.42	3.80
Leadership	179	5.37	3.45

Note. From "Factors contributing to the successful implementation of technology innovations" by Ensminger, Surry, Porter, Wright, 2004, *Educational technology and society* 7 (3), p 11.

This proactive approach is in contrast to Ely's (1999) reverse engineering, post implementation approach of investigation. Although a pre-implementation profile is justified for

a planning stage, research reveals that unanticipated or latent factors can evolve in programs during and particularly after deployment (Boone, 1992), issues surrounding use and application can be multifaceted and become more apparent after adoption (Abbott & Yarbrough, 1999), and the presence of Ely's conditions may be outcomes of use (Ravitz, 1999). Surry and Ensminger's current research has centered on hypothetical scenarios as opposed to real innovations and contexts. Similarly, such hypothetical scenarios cannot adequately represent survey respondents or identify conditions that may not surface until an innovation is adopted and utilized. Research is needed to assess variances that may be found to exist in terms of the importance of these conditions perceived prior to and after (or during) implementation as suggested by Ravitz (1999). As Ravitz (1999) proposes, a proactive assessment allows one to create an environment favorable for implementation, and measuring progress toward implementation goals should be assessed during and after implementation. The literature suggests that factors affecting implementation can arise during and after implementation (Boone, 1992). As such, variances in the importance of the conditions may exist at different stages of implementation. Ravitz (1999) states that an instrument for planning and assessing implementation from this perspective would be invaluable. Ensminger and Surry at iphase.org have attempted to create that instrument with the Implementation Profile Instrument (IPI).

Making generalizations across innovations, contexts, and populations can be questionable without further study of more recent innovations within a real context where the innovation passes from the pre-implementation phase then to use, and where a supportive infrastructure exists and assessed adopters share similar experiences and degrees of expertise with the innovation. This study attempts to further assess the predictability and credence of Ely's (1990) conditions from this perspective by assessing conditions prior to and after the implementation of a software application.

This study controlled for environmental variables in part through an investigation of the importance of Ely's conditions as perceived by a specific group of adopters within a single organization. The rationale for the investigation of a single organization or system is presented in the literature. Organizational systems and change are complex, making generalizations across systems nearly impossible due to the unique environment, implementation strategies, and local conditions each system possesses, and the innovation to be implemented (Bauder, 1993; Berman, 1981; Berman and McLaughlin, 1976; Ensminger, Surry, Porter, and Wright, 2004; Jeffrey, 1993). Among questions proposed for future research include: are the factors considered important consistent and "do the profiles generated from the implementation instrument reflect the conditions that people think are important when implementing a new technology?" (Ensminger, Surry, Porter, & Wright, 2004, p. 14). The Implementation Profile Instrument and research methodology developed by Ensminger, Miller, and Surry (2002) will be presented in chapter three and adapted to answer the following questions within the context of this study:

1) What are adopter perceptions toward the relative importance of Ely's conditions?
2) Do perceptions regarding the relative importance of Ely's conditions differ between pre-implementers and post-implementers?
3) Do perceptions regarding the relative importance of Ely's conditions differ between pre-implementation and post-implementation?

As presented in the literature and used in this study, adoptions occur when an innovation has been selected for use and implementation occurs when an innovation is put to use. Although all implementers are adopters, it is possible for an individual to be an adopter without being an implementer.

CHAPTER 3: RESEARCH METHODOLOGY

Introduction

The methodology for this study focused on a specific product innovation, context and adopter group (engineers). Holloway (1996) states, "studies that focus on the social context of technology for decision makers, teachers, publics [people within the organizational system], and students are the most productive new perspectives for diffusion and adoption research" (p. 1130). A technology or innovation within a social context is described in the literature of instructional technology innovations as being one of two types of innovations: *process* and *product* innovations. *Process innovations* involve organizational reform, restructuring and broad systemic changes in processes. *Product innovations* are concerned with a specific instructional product and the adopter group and environment, as well as assessing ways to increase the innovations' adoption and utilization through an "instrumentalist" "adopter-based" perspective (Farquhar & Surry, 1997). This adopter-based perspective aligns itself best with the "social context of technology" referred to by Holloway (1996). Based upon the definition of a product innovation, this software was considered as a technology/product innovation for investigation in this study within the social context of an engineering firm.

Ely's (1990; 1999) environmental conditions for implementation provided the theoretical framework for investigation. An instrument developed specifically for the purpose of assessing the importance of Ely's conditions as perceived by individuals is the Implementation Profile Instrument (IPI). The IPI and methodology (Anderton, Amarasing, Ensminger, & Surry, 2003) was adapted to measure employee perceptions of the relative importance of Ely's (1990; 1999) conditions believed to be necessary for the successful implementation of a product innovation.

Rationale for the Method

The survey methodology and descriptive statistics proposed for this study can be justified from several perspectives. Ely (1999) has stated that change is "difficult to discuss in simple empirically-based paradigms" (p. 152). Due to the interrelationships of Ely's conditions, an empirical investigation of a single condition or factor in implementation is also difficult (Bauder, 1993; Ravitz, 1999). Furthermore, Rogers (1995) has acknowledged problems assessing cause-effect relationships in diffusion analysis. Knupfer and McLellan (1996) note that variables cannot always be isolated to explain causes:

> …descriptive research can play an important role in providing information from another perspective. By gathering descriptions of 'what is' and comparing them to 'what we would like', educators can see the area that needs to be addressed…descriptive statistics can provide information that can help to isolate the variables that will eventually be used to measure cause and effect, and at the least can help provide surrounding information that will aid logical interpretations of research questions within the context of a specific situation. (p. 1210)

Holloway (1996) states that much of "dissertation descriptive research suffers from unreplicated one-shot studies" (p. 1119). In response to this issue, the use of the Implementation Profile Instrument in this study, to a degree, replicated a prior investigation from a different context.

> Descriptive research has grown in acceptance due in part to a belief that a purely scientific approach reduces educational research to trivial questions that do not address the important, overarching issues within education…rapidly changing technologies available to educators have everyone scrambling for information…it is difficult to set up control groups that adequately control all of the variables that might affect the outcome. (Knupfer & McLellan, 1996, p. 1210)

Knupfer and McLellan conclude that educators are interested in results and seek to ascertain how others are utilizing and implementing new technologies. Descriptive research addresses these concerns and identifies patterns, prescriptions, recommendations, and future directions for instructional designers and educators (Knupfer & McLellan, 1996).

Survey Methodology

The IPI is designed to evaluate adopter perspectives. Such survey methodologies are designed to assess subjective judgments when precise analytical techniques cannot be used (Linstone & Turoff, 1975). Also, time is an invaluable commodity for employees, and a web-based survey reduces the amount of time required for their participation. Web surveys are believed to be a dominant form of data collection in the 21st century (Dillman, 1998), and survey methodology continues to be the prominent research design in diffusion and adoption of educational technology (Holloway, 1996).

Recent survey measurement research fails to reveal that interview methods versus self-administered surveys are inherently better at producing quality data (Dillman, 1998). Several aspects of web survey research are inconclusive, such as the effects of visual and hand-eye coordination on responses between different types of web-based surveys (Dillman, 1998); contentions that responses will differ with survey mode; and improving response rates by providing participants with a choice in survey mode or left versus right aligned web-based questionnaires (Bowker & Dillman, 2000). One other inconclusive area is the primacy-recency effect on responses pertaining to a list of items to evaluate (Dillman, et al., 2001).

Advantages and Disadvantages

Survey was chosen over interviews as the primary research instrument due to several advantages. Interviews can be intrusive, results may be skewed by interviewer/interviewee personalities, quality is dependent upon interviewer experience, knowledge, skill and training; data analysis is time-consuming, and issues surround subjectivity in data collection, transcription and selection, and how data is condensed and analyzed (Patton, 1990; Pedhazur & Schmelkin, 1991). Questionnaires provide confidentiality and anonymity, are less susceptible to researcher bias with regard to administration, and have the potential to assess a greater number of subjects in a less time consuming and costly manner (Pedhazur & Schmelkin, 1991).

A web survey as opposed to paper-based surveys was utilized as such administration is considered to be efficient, less costly, and an expected method in a culture moving towards "self-administration" (Dillian, 1998, p. 11). The perception of web-based surveys as being less costly and a more efficient approach has been questioned in a RAND corporation report (Schonlau, Fricker, & Elliott, 2001). However, when compared to email, a web-based survey only requires

access to the Internet and the survey provides a better means of assuring that all members of a sample have a chance of being selected in that members of a sample may possess multiple or no email addresses if administered via email. For this study, a web-based survey was used to collect participant responses. Employee e-mail addresses were used to notify participants of the location of the web-based survey and to encourage them to complete the survey. Web surveys, through a more standardized format of delivery, also eliminate some of the issues surrounding software/equipment incompatibilities that participants may experience through a less standardized format for delivery.

A disadvantage in survey methodology is that it is more restrictive and does not provide the opportunity to uncover other constructs since points-of-view are predetermined through the wording of the question (Patton, 1990). Misinterpretations of questions can contribute to "nonsampling errors", and operationalizing constructs of education technology "truncates the range and richness of the results" (Holloway, 1996, p. 1113). As an investigation of the existence of a predetermined set of conditions (Ely, 1990b; 1999) within an established framework and replicated methodology (Anderton, Amarasing, Ensminger, and Surry, 2003), the restrictive nature of this study is justified. Operationalizing the conditions to the context for this study serves as a means of improving the interpretation of survey questions among participants, thereby, reducing nonsampling errors. This involves constructing questions in a manner that is representative of the specific innovation and context under investigation. Uncovering other constructs has been investigated, as presented in the literature, and continues to serve as a future avenue for further research but is not a focus of this study.

This researcher conducted a pilot study during the spring of 2003 involving three university faculty members at three different universities in an attempt to assess faculty perspectives of Ely's (1990) eight conditions. Telephone and personal interviews were conducted. Operationalized definitions of the conditions were *not* provided in an attempt to uncover other constructs, interpretations, and definitions of the conditions from their perspective as it related to their adoption and implementation of a CMS. Results of the study revealed that faculty had difficulty in conceptualizing the conditions without examples or definitions (operationalizing the constructs). The findings further supported the need to "operationalize" constructs, as presented in this study, to limit problems with participant interpretation of questions.

Setting

This study consisted of a pre and post-implementation investigation of the importance of Ely's conditions as perceived by engineers adopting a product management software application at an engineering firm. The firm chosen for this study is a global leader in wireless technology and component design. In an effort to improve product development and collaboration, the company acquired the services of a product development and product lifecycle management company. The goal of product development/lifecycle management is to produce an infrastructure for product management throughout the lifecycle of a product. Software developed for these solutions assists engineers and manufacturers with successful product development through three primary components: product management, collaboration, and change management software. The "change management" component of product development,

consistent with instructional design models in scope, is composed of planned or proposed change, design, implementation and evaluation.

Within the realm of these software products is a program comprised of a set of online collaboration tools that enable online product collaboration and development with project teams. The change management component of this program, and the innovation to be investigated for this study, was chosen as the replacement for the engineering firm's previous document control application, due to its more elaborate collaboration and knowledge management features. This new program was designed specifically to allow development teams to manage product change and information more efficiently, including product requirements and specifications. The program works interdependently with the program's project management and collaboration applications.

Educational and instructional implications within these programs are inherent in the product. Learning within the application occurs from capturing the workflow in a structured way through collaboration, and recognizing where changes can be made to reduce time and/or cost from the experience of previous products. Newcomers to the development process learn how a product evolves from concept to production. Experienced people will use the tool to learn how to improve upon "concept to production" and innovate and develop faster. From an instructional perspective, the system provides everyone who utilizes it a clear picture of each step toward product development, and the requirements. It is a "stage-gate" implementation; one cannot proceed to the next gate until certain items are fulfilled. Furthermore, the collaborative, online system offers users access to dissemination of knowledge, a dominant application of technology in organizational development (Kaplan & Godwin, 2004).

Ely (1976) equates this more narrow focus of study on one system and one innovation as analogous to medical research; understanding change in "small proportions" increases the likelihood of formulating generalizations to a much larger problem (p. 159). Recent studies applying Ely's (1990) framework from an instructional technology perspective have been broad in nature in terms of innovation and context. These have centered on technologies such as the Internet and teacher use (Ravitz, 1999), which conditions best predict the implementation of computers into elementary and secondary curricula (Bauder, 1993); general applications of instructional technologies (Burton & Danielson, 1999); and a study investigating the importance of Ely's conditions in the implementation of an online education program (Ensminger, Miller & Surry, 2002). Studies of online project management systems as the innovation, utilizing Ely's framework, have not yet been addressed due, in part, to the novelty of the technology. Any consistencies in findings with this innovation can contribute toward a greater understanding of successful implementation with similar innovations in this technological era.

Implications for this research reside in improved policy decisions regarding technology innovations, and instructional design where conditions facilitating implementation provide an additional guide during the entire design process (Ensminger, 2001). This research also attempts to connect research and practice (Farquhar, Harmon, Jones, Land & Surry, 1998). Farquhar et al. (1998) state that results of research should be valuable to others; "the connection between practice and research should be made stronger…[research] needs to make a greater impact on the environments in which we work; our research results need to be practical" (p. 5). Maddux

(1995) similarly proposes a move toward more practical and applicable studies. Lagemann (2003) has also expressed the need to link educational theory and practice in ways that will generate new knowledge that positively affects policy, and a need to direct attention to day-to-day teaching in real-world settings. In 1999, Ely saw the study of implementation as a neglected and worthy area of study in this regard: studies of implementation as investigations of real-world environments where an innovation has been put to use. Ongoing advances in technology have stimulated interest in studies examining the conditions that facilitate the retention, implementation and use of technologies (Bauder, 1993; Burton & Danielson, 1999; Carter, 1998; Ely, 1999; Ravitz, 1999; Surry, Ensminger & Miller, 2002).

The literature suggests that environmental conditions can influence the strength of Ely's conditions (Ely, 1990b; 1999), and perceived barriers decrease as infrastructure matures (Berge & Muilenburg, 2001). Perception of the technology's use, purpose (Tatnall, 2001) and its benefits (Moore, 1999) can vary among individuals. Furthermore, factors for implementation can evolve after deployment and use (Abbott & Yarbrough, 1999; Boone, 1992; Ravitz, 1999). Adopter perspectives can be influenced by their stage of concern or awareness (Askar & Usluel, 2001; Hall & Hord, 1987), experience and knowledge (Bruer, 1994; Cloutier, 2001; Dooley, 1999; Ravitz, 1999; Sherry et al., 2000) level of use of the technology (Dooley, 1999) and whether the technology is undergoing implementation or has been institutionalized (Rogers, 1995).

Considering the factors above, predictability and credence of Ely's (1990) framework and this instrument were strengthened in this study through a pre and post-implementation investigation of a specific innovation designed for a specific purpose within a single context and adopter group. This was an effort to control for stage of implementation, adopter and innovation characteristics and variables, variants in innovation usage and purpose, experience and knowledge, awareness, and infrastructure. For this study, the engineering firm assumed an active role in the diffusion of the product management software through a well-established implementation and support team. This pre and post-implementation investigation of a real product in a real context provided an appropriate context for measurement and a sharp contrast to earlier studies that employed either pre-implementers only, or a hypothetical setting as was employed in the reliability tests and recent applications of the Implementation Profile Instrument**.** This setting ensured that participants shared similar experiences, and perceptions were not affected by factors cited earlier, factors that could confound user responses and analysis.

Participants

Subjects for the study consisted of engineers employed at an engineering firm. This firm employs approximately 1000 engineers. Groups of employees implemented the new software over a period of eighteen months beginning May of 2005. For this study, the firm's implementation team leader made available for sampling purposes a single group of adopters (N=500) of the software employed at several sites across the United States. Participant selection is considered to be more important than group size in ensuring a successful research design (Gordon, 1994), and users of an innovation are considered to be a valuable source in assessing implementation issues (Ansorge & Cooley, 2001; Bober, 2002; Carr-Chellman & Whetstone, 2001; Cuban, 1999; Dooley, 1999; Dove & Fisher, 1999). A follow-up post-implementation

survey and analysis of the same adopter group was conducted in an effort to avoid difficulty in conceptualizations of the software, a problem that may be characteristic of novice users (Bruer, 1994; Lewis & Orton, 2001; Ravitz, 1999). Most participants for this study also used a similar tool; successful use ensures that perceived self-efficacy is similar (Bandura & Wood, 1989).

Participants, as knowledgeable adopters regarding the purpose to the software, represent an adopter group for this study that will minimize socially desirable responses or responses believed to promote agreement, both characteristic of novices (Patton, 1990). Their perceptions of a specific tool such as the product management software within the context of a single company ensure that participants share similar general experiences with regard to use, a key factor for valid assessment (Askar & Usluel, 2001). During post-implementation analysis participants are more aware of environmental issues and conditions as opposed to participant responses to fictitious or hypothetical contexts, anticipated uses, and among participants within a transitional implementation stage.

Instrument

The Implementation Profile Instrument (IPI) was utilized as the survey instrument for data collection. A pilot test of the instrument was conducted using two department leaders and the director of technology. The IPI was developed as part of the Implementation Phase Research Project (iphase.org) during 2002 for the measurement of these conditions from a proactive, pre-implementation versus post-implementation perspective for the purpose of assessing adopter profiles to better assist organizational change agents and instructional designers in process or product implementation efforts (Anderton, Amarasing, Ensminger, & Surry, 2003). Prior to this study, the IPI had yet to be employed in a "real" context or as a post implementation profile assessment. The IPI consists of 56 questions. As a means of achieving more reliable measurement of participant's perceptions, each question matches or compares a single condition to every other condition (e.g., "participation" and "commitment") twice, thereby, providing a participant with 14 opportunities to select each condition. This pairing of one of the eight conditions with all of the other seven conditions twice generates the 56-item instrument. Presenting conditions to evaluate in pairs, as opposed to a long list of constructs, may reduce the possibility of primacy-recency effects on responses that may be more likely with a longer list of items for evaluation (Dillman, et al., 2001). A single pair and question was presented on one screen in order to prevent participants from framing their response to one comparison in the context of another (Schonlau, Fricker, & Elliott, 2001). Incorporating a single question per screen versus the use of a scroll bar minimizes the effort required by the participant to respond (Dillman, 1998). Input was automatically validated.

A score from 0-14 was possible for each condition. The score was dependent upon the number of times a participant selects the particular condition. A score of 14 for a particular condition would indicate that a participant chose that condition each time it was paired with another. For example, the following compares the condition Resources with Commitment:

I would be more likely to change to this software if…

- I had access to it whenever I needed to use it
- Upper management is visibly and actively supportive of it

The score generated by the participant represented his/her "implementation profile" and the perceived relative importance of each condition.

Two versions of the IPI were created as a means of assessing either process innovations or technology/product innovations. A content validity study was conducted for the instruments in which questionnaire items were reviewed by a panel of seven outside experts (Ensminger, Surry, Porter & Wright, 2004). Thirty-two statements defining the conditions, sixteen for each of the two versions of the instrument, were independently developed. On a scale from 1 (low) to 5, experts were asked to rate how well a statement represented a condition. Experts were also allowed to provide feedback concerning any statement. An average score of 3.5 or higher on any statement was determined to be a valid representation of the condition. Average scores ranged from 2.6 to 3.5. Ten of the 32 statements had average scores above 3.5 and seven were between 2.6 to 2.9. Six statements rated between 3.3 or 3.4 with one or two experts rating the statements below 3. Considering this, these six statements were accepted as valid. The remaining statements were rewritten incorporating the suggestions and comments provided by the experts. The researchers then asked colleagues with experience in questionnaire development to review a paper-based version of the instrument for format and face validity. Changes were made based on their input.

The IPI underwent two different reliability studies. A test/retest reliability study was conducted during January, 2003 through May, 2003 (Anderton, Amarasing, Ensminger, & Surry, 2003) and another during October, 2003 (Porter, Surry, & Ensminger, 2003). The technology innovation reliability study investigated an individual's pre-implementation perspectives relating to the implementation of a fictitious new computer system at a university. Porter, Surry, and Ensminger's (2003) test/retest reliability study, testing 14 days apart, consisted of graduate students (N=39) of various occupations, ethnicity, gender, educational level and technical expertise enrolled in graduate level classes in education. Participant ages ranged from the early 20s through middle 50s, and all had at least an undergraduate education (Porter, Surry, & Ensminger, 2003).

Preliminary results for both the process and technology instruments were found to be reliable; however, due to a fewer number of participants involved in the process innovation version, the authors expressed only a moderate level of confidence and recommended further study. The technology instrument to be used in this study was found to be most reliable "in determining a person's implementation profile over time and can be used with a certain high degree of confidence for future research in this area" (Anderton, Amarasing, Ensminger, & Surry, 2003, p. 5). Each condition had reliability scores ranging form .586 to .864. The average of all eight reliability scores was .730, and all were significant at the .01 alpha level (Ensminger, Surry, Porter and Wright, 2003). Individual retest reliability coefficients are presented in Table 5.

Table 5

Test/Retest Coefficients

Condition	Coefficient
Status Quo	.586
Knowledge/Skills	.646
Resources	.687
Time	.761
Participation	.773
Rewards	.864
Commitment	.782
Leadership	.778

Note. From "Factors contributing to the successful implementation of technology innovations" by Ensminger, Surry, Porter, Wright, 2004, Available from iphase.org.

The purpose of the study and context was clearly described within the survey. Patton (1990) contends that the context must be made clear to participants in order to allow them to relive their experiences. Operationalizing the conditions to the context and innovation under investigation ensures consistency in structure and format, and assures that the same information is obtained from all participants. In order to reduce the occurrence of sample survey errors such as nonresponses, a "respondent-friendly design" was employed limiting advanced programming features, incorporating simple navigation, a "plain version design", a left aligned questionnaire (Dillman, Tortora, & Bowker, 1998), and forced responses.

The firms's manager of engineering process systems and the director of technology conducted an assessment and pilot test of the instrument during January 2005 to determine the appropriateness of the questions and any flaws within the online survey. The firm's director of technology approved the survey followed by approval from the Virginia Tech Research Compliance Office.

Procedure

Following the format utilized for the initial use of this instrument by researchers at iphase.org, the order of the pairs of conditions presented in the questionnaire was randomized to reduce pattern responding. A web form was made available online which included consent, explanation of the purpose of the study, and the questionnaire (Appendix B). The participants were required to answer all 56 questions before submission of the survey was allowed. If the survey was interrupted, the participant was directed to the point in the survey where the interruption occurred. All participant responses were anonymous. The time that was required to complete the questionnaire was approximately 20 minutes.

The same adopter group was asked to complete a similar survey six months later for a post-implementation analysis. As discussed in the literature review, implementation occurs when an innovation is put to use, and perceptions of conditions for successful implementation

can change and evolve at any point during phases of the implementation process. This particular point during post-implementation was selected in an effort to capture perspectives before the innovation became completely institutionalized, a very active time, within the organization while allowing adopters time to acquire a degree of experience with the software. Participants were expected to utilize the software nearly every day thereby allowing ample time to achieve proficiency during this post-implementation phase.

The firm's implementation team leader identified participants in the adopter group. Prospective participants were emailed requesting their participation in the study, and the online survey URL. Such pre-notification for participation via email was done as a means of increasing web survey response rates (Sheehan, 2001). Methods to improve response rates are inconclusive with regard to non-monetary incentives and Web surveys; however, factors such as university affiliation has been shown to improve response rates in general (Sheehan, 2001). Motivation is believed to be difficult in subject participation, however, as members of a peer-nominated sample, such association was hoped to instill a sense of value for their effort. The salient nature of the study also ensures a degree of motivation to participate (Sheehan, 2001), and by surveying members of a profession regarding issues of professional interest, such as this, response rates of 70% to 80% can be achieved (L.H. Cross, personal communication, October, 1997). In terms of generalizing findings to the population of 1000 engineers at this firm, a sample size of 278 is needed (Krejcie & Morgan, 1970). No-response errors due to hardware/software or access incompatibilities were minimized as a result of using a web-based survey.

Analysis

Consistent with the initial use of this instrument (Anderton, Amarasing, Ensminger & Surry, 2003), a web-based survey was utilized for data collection upon which the data was exported to an Excel spreadsheet for subsequent import into SPSS for statistical analysis. Cohen's kappa (Cohen, 1960) was employed to determine intrarater reliability among participant pre and post-implementation responses. Nonindependent ratings can affect the magnitude of the kappa coefficient and occurs when the rating given during the first assessment influences the rating during the post assessment (Sim & Wright, 2005). To address this, the survey incorporated two methods in the design. First, the condition pairs were presented at random, and secondly, the post-survey was administered after approximately six months had passed.

Descriptive statistical analysis, consisting of frequency charts, cumulative percentages, standard deviations, and mean values were conducted to uncover individual implementation profiles, the relative importance of Ely's (1990) conditions, and differences in responses between pre and post-implementation. The literature reveals that smaller, more homogenous groups should have less variation (Dekimpe, Parker, & Sarvary, 1997; Ehrmann, 2001), however, variations in environments from one locale to another may influence perceptions among engineers within the global corporate environment at this firm.

Data from the initial use of the instrument also were analyzed using a factor analysis. To be consistent with the earlier application (Ensminger, Surry, Porter & Wright, 2004) a factor analysis of the data from this study was conducted using the principle component method of extraction and varimax rotation. This method is designed to identify any underlying factors

within the data. As with the earlier application, a condition was viewed as loading on a factor only if it had a minimum absolute value of .45 and had not loaded on another factor at an absolute value of .45 or greater. Garson (n.d.) states that loadings should typically be .70 or greater; however, real-life scenarios may not reach that level and values such as .4, particularly for exploratory research, are sometimes used for "central factors." In any event, he contends that it is theory that should underpin interpretation, not arbitrary cutoff points. In regards to factor labels, Garson states that attempting to assign factor labels for the purpose of bestowing meaning to factor loadings is a very subjective and difficult process. Factor labels were not employed in this researcher's study.

CHAPTER 4: RESULTS

Research questions investigated in this study are:

1) What are adopters' perceptions toward the relative importance of Ely's conditions?

2) Do perceptions regarding the relative importance of Ely's conditions differ between pre-implementation and post-implementation?

3) Do perceptions differ between pre-implementers and post-implementers?

As stated earlier, adoptions occur when an innovation has been selected for use and implementation occurs when an innovation is put to use. Although all implementers are adopters, it is possible for an individual to be an adopter without being an implementer. For this reason, Research Question 1 focused on adopters.

Research Questions 2 and 3 acknowledge the possibility that perceptions of conditions needed for successful implementation can change and evolve at any point during phases of the implementation process. Therefore, assessing perspectives before and after the deployment process provides an understanding of whether or not perceptions of the factors affecting implementation changed and identifies which factors may need to be addressed to facilitate success. The purpose of the pre-implementation survey was to assess participant perspectives prior to the implementation of the innovation. At this point the organizational commitment to adopt the innovation had occurred but implementation had not yet occurred. The period selected for the post-implementation survey was made in an effort to capture perspectives after the innovation became institutionalized within the organization, while allowing adopters time to become implementers and acquire a degree of experience with the software.

Data Analysis

The raw data collected were examined to eliminate invalid records. All records with incomplete responses, i.e., where the actual number of responses was less than the total number of items possible (N=56), and all data used for testing/debugging of the survey were eliminated. Data reduced as follows: 105 participants completed either the pre or post survey, with 63 participants completing the pre-implementation survey and 42 participants completing the post survey. All 105 participants were treated as adopters. The 42 adopters who completed the post survey were also classified as implementers. Of the 42 implementers, 5 completed only the post-implementation survey while 37 completed both the pre and post survey. As a result, 37 participants are represented twice, once as a pre-implementer and again as a post-implementer.

Reliability of the data was examined separately for the pre-implementation survey and the post-implementation survey. The analysis for each of the surveys was based on the extent of the agreement (the proportion of responses in agreement after chance was excluded) between the two participant responses for all possible pairs of conditions using Cohen's kappa (Cohen, 1960, cited in Howell, 1997). The upper limit of the Kappa coefficient is represented as +1.00 (total agreement), chance level as 0.00, and the lower limit as –1.00 (total disagreement).

Analysis revealed that the level of agreement between individual participant response pairs within both the pre and post-survey instruments, although moderately low (Sim & Wright, p. 264), exceeded what should be expected by chance (or random selection of responses), and suggests a valid assessment of participant perspectives utilizing the survey instrument (IPI). The kappa values (mean proportion of agreement) are presented in Table 6.

Table 6

Kappa Coefficients

Participants	Kappa Value (Group Mean)
Pre (n=63)	.379
Pre (n=37)	.398
Post (n=42)	.373
Post (n=37)	.386

Research Question One

The first research question examined adopters' perceptions toward the relative importance of Ely's conditions. This question was explored through the use of descriptive statistics. The relative importance of Ely's eight conditions, as perceived by adopters, was determined by the number of times a condition was selected when compared with all other conditions. For each pair that was presented to the adopter, a value of 1 was assigned to the condition that was selected and a value of 0 was assigned to the condition that was not selected. Within both surveys, each of the eight conditions was compared twice with 7 other conditions. For each adopter in a survey, a condition could receive a total maximum value/weight = 14, a total minimum value/weight = 0, or some other total value between 0 and 14. Mean total values and standard deviations for each condition-combination for all participants (N=105) in both surveys were analyzed to assess all adopter perceptions.

Table 7

Descriptive Statistics for Adopters (N=105)

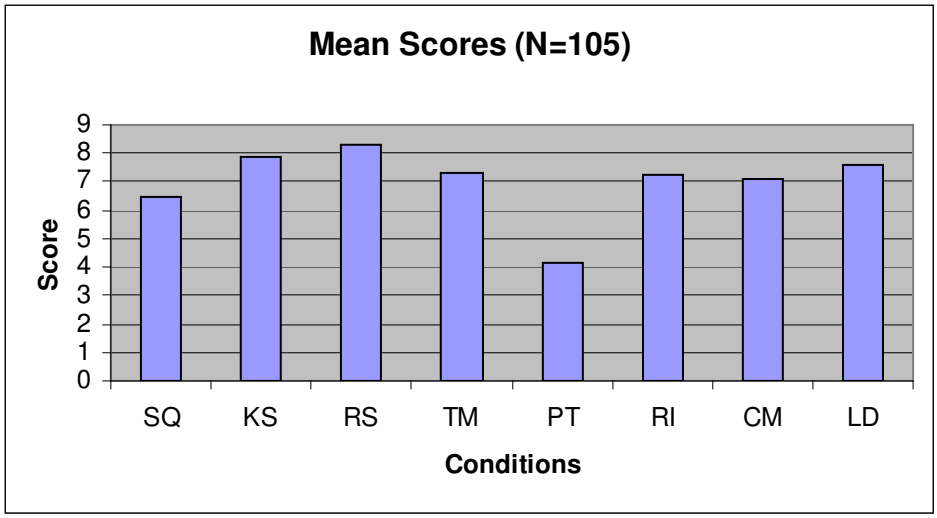
	SQ	KS	RS	TM	PT	RI	CM	LD
Mean	6.5	7.9	8.3	7.3	4.1	7.3	7.1	7.6
Median	6.0	8.0	8.0	7.0	3.0	7.0	6.0	8.0
Std. Deviation	4.2	3.7	3.2	3.1	3.6	3.7	4.1	4.1
Variance	17.4	13.3	9.9	9.6	12.7	13.6	17.1	16.5

Note: Status Quo (SQ), Knowledge/Skills (KS), Resources (RS), Time (TM), Participation (PT), Rewards/Incentives (RI), Commitment (CM), Leadership (LD).

The mean total scores for each condition for all participants show that Resources, Knowledge / Skills and Leadership are perceived as most important (Table 7). Participation and Status Quo are perceived as least important.

As shown in Table 7, five of the eight conditions had mean scores that were closely grouped between seven and eight. One condition had a mean score exceeding eight and two conditions had means under seven. These results are graphically represented in Figure 1.

Figure 1. Mean Scores for Adopters (N=105).



Although mean scores provide a look at the central tendencies associated with responses, they also can hide valuable information within data. That phenomenon is true in this case. An examination of the frequency with which the total scores occurred demonstrates the importance of some perceptions that may be masked by use of mean scores. For example, in the Frequency of Score Occurrence table (Table 8), the condition that most frequently received the highest possible score (total score=14) was Commitment, which was identified by 12 participants as more important than all other conditions. Yet Commitment does not appear among the three most important conditions when viewed from the perspective of mean scores. Similarly, Status Quo received a score of 13 or 14 from more respondents than any of the top three conditions identified through the use of mean scores. Yet Status Quo received the second lowest score when based on mean scores. Also, while Leadership was among the top three conditions when rated according to mean scores, the frequency table shows that 7 respondents rated Leadership as more important than all other conditions and an equal number of respondents, 7, rated Leadership as less important than all other conditions.

Table 8

Frequency of Score Occurrence (N=105)

Score	SQ	KS	RS	TM	PT	RI	CM	LD
14	4	3	2	1	1	4	12	7
13	8	8	8	2	2	6	4	4
12	4	14	6	6	1	6	6	9
11	4	8	15	8	1	8	1	13
10	10	4	13	10	3	5	5	5
9	6	7	8	16	6	8	10	10
8	6	14	11	8	9	15	8	5
7	10	6	10	9	4	11	5	10
6	7	10	9	16	6	7	14	8
5	9	10	10	7	8	9	7	10
4	5	8	6	11	11	9	11	6
3	6	6	3	5	13	4	9	2
2	12	2	3	2	8	4	4	6
1	8	3	0	2	12	7	3	3
0	6	2	1	2	20	2	6	7

The above results demonstrate that Research Question 1, i.e., adopters' perceptions toward the relative importance of Ely's conditions cannot be answered clearly by using a combination of pre and post implementation responses. Using measures of central tendencies provides one approach to rating the importance of Ely's conditions. However, this certainly is not the only approach and, as the above discussion demonstrates, it possibly is not the best approach to address this purpose. How often a condition is selected relative to other conditions varies considerably both within and among conditions. Since the cause(s) of this variation cannot be determined by reviewing only the data for all respondents, other approaches must be employed. These approaches are examined in the sections of this document dealing with Research Questions 2 and 3.

Research Question Two

The second research question examines whether or not perceptions regarding the relative importance of Ely's conditions differ between the pre-implementation, or adoption, stage and the post-implementation stage. (Note: Pre-implementation survey respondents may be viewed as adopters while post-implementation survey respondents may be viewed as implementers.) This question was explored through the use of descriptive statistics and factor analyses.

Based on descriptive statistics, some perceptions differed between pre and post-implementation stages while others did not (see Table 9). A comparison of the rankings of pre-implementation (n=63) and post-implementation (n=42) survey groups illustrates that Resources and Knowledge/Skills rank the most important before implementation of the innovation while Commitment, Resources and Leadership are ranked most important after the innovation has been implemented. Participation ranks least important in both sample groups (pre and post

assessments). Among all conditions, Commitment experienced the greatest degree of change in importance increasing from seventh among pre-implementers to first among post-implementers. Rewards and Incentives and Skills and Knowledge both decreased in importance by three positions from pre to post-implementation. Finally, the ranking of two conditions, Participation and Status Quo, remained constant between the pre and post implementation surveys. These results are graphically represented in Figure 2.

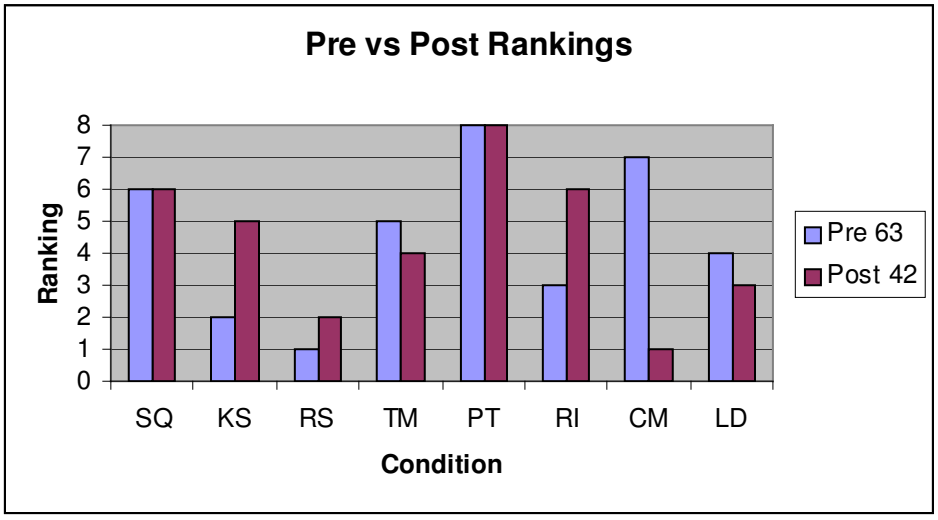
Table 9

Total Scores and Rankings, Pre (n=63) and Post (n=42) Implementation

	SQ	KS	RS	TM	PT	RI	CM	LD
Total Score Pre (N=63)	418	512	523	433	311	500	382	449
Mean Score	6.6	8.1	8.3	6.9	4.9	7.9	6.1	7.1
Ranking	6	2	1	5	8	3	7	4
Total Score Post (N=42)	263	314	349	334	123	263	361	345
Mean Score	4.2	5	5.5	5.3	2	4.2	5.7	5.5
Ranking	6	5	2	4	8	6	1	3

Note. 1=Highest Ranking, 8=Lowest Ranking

Figure 2. Rankings Based on Total Scores, Pre (n=63) and Post (n=42) Implementation



Note. 1=Highest Ranking, 8=Lowest Ranking

In addition to the descriptive statistics presented above, two factor analyses were conducted to identify factors that are strongly related and that explain most of the variance

among and within conditions. Factor analysis is a procedure whereby a relatively large number of conditions are reduced to a smaller number of factors (Garson, n.d.). The smaller number of factors provides a means of detecting linkages or relationships between conditions, and assessing classifications of the conditions through these linkages. The principle component method of extraction and varimax rotation was employed whereby values loading on a single factor signify a strong coefficient loading. Factor loadings are correlation coefficients between factors or, in these analyses, between the conditions. A high value indicates that the extracted factor represents the variables well. Positive coefficients represent direct relationships whereas negative coefficient values indicate inverse relationships. As described within the methodology section of this study, factors with absolute values = or > .45 were viewed as loading. In both the pre and the post factor analyses, Ely's conditions reduced to four factors. However, the reduced factors were different between pre and post-implementation.

During pre-implementation (N=63) conditions loading on the first factor were Time and Commitment. This loading accounted for 20.32% of the total variance. The conditions Resources and Rewards loaded on the second factor (19.21% of total variance), Participation and Leadership (18.49% of total variance) on the third factor, and Status Quo and Knowledge/Skills on the fourth factor (15.03% of total variance). The four extracted factors accounted for 73% of the variance. Factor loadings ranged from -.823 to .866.

Table 10

Factor Loadings (73% of Variance) for Pre-implementation (n=63)

Conditions	Factors			
	20.32%)	19.21%	18.49%	15.03%
Status Quo	.216	-.186	-.048	.866
Knowledge/Skills	.419	-.204	-.152	-.646
Resources	.000	.832	.260	.027
Time	.751	.196	-.082	-.070
Participation	-.274	.023	.791	-.027
Rewards/Incentives	.042	-.796	.242	.079
Commitment	-.810	.307	-.138	-.120
Leadership	-.326	.023	-.823	-.093

During post-implementation (N=42), four factors extracted, accounting for 78.5% of the variance. Conditions loading on the first factor were Knowledge/Skills, Commitment, and Leadership representing 26.92% of the total variance. Conditions loading on the remaining three factors were: Status Quo (19.89% of total variance), Time and Rewards/Incentives (15.92% of total variance), and Participation (15.78% of total variance). Factor loadings were higher ranging from -.863 to .914. The post-implementation factors represented a larger portion of the variance, up over 5% from the pre-implementation group.

Table 11

Factor Loadings (78.5 % of Variance) for Post-implementation Conditions (n=42)

Conditions	Factors			
	26.82%	19.89%	15.92%	15.78%
Status Quo	.256	-.863	-.088	-.192
Knowledge/Skills	.754	.111	.043	.132
Resources	.357	.812	.051	-.079
Time	.251	.140	.762	-.376
Participation	.197	.094	-.001	.914
Rewards/Incentives	.325	-.017	-.797	-.360
Commitment	-.784	.344	-.074	.203
Leadership	-.755	-.171	.201	-.231

Research Question Three

The third research question investigated differences in perceptions as participants went from pre-implementers to post-implementers. Thirty-seven people responded to both pre and post implementation surveys. Unlike other participants who responded to only one of the surveys, the responses for each of these thirty-seven individuals could be compared from pre to post surveys and any similarities and differences between the survey responses could be examined. Because of this, both relative rankings and total scores could be compared between pre and post implementation.

Descriptive statistics revealed that the ranking of some perceptions changed as individuals moved from being pre-implementers to being post-implementers while other perception rankings remained the same (see Table 12, Figures 3 and 4). A comparison of the pre and post-implementers' responses illustrated that Knowledge/Skills and Rewards/Incentives ranked the most important before implementation of the innovation while Commitment and Leadership were most important after the innovation was implemented. The relative importance of Participation and Resources did not change. Participation ranked least important in both pre and post assessments. Among all conditions, Commitment represented the greatest degree of change in rankings, increasing from sixth among pre-implementers to first among post-implementers.

Comparisons of pre versus post-survey rankings and changes in score totals reveal that Knowledge/Skills and Rewards/Incentives decreased in ranking by four positions from pre to post-implementation, yet its relative degree of importance dropped only 8.1%. Rewards/Incentives similarly dropped four positions in ranking, however its relative importance decreased 22.4%.

Respondent's perception of Status Quo changed the least (3.2%), followed closely by Resources (3.4%), while Commitment changed the most (up 44.8%). The condition Participation dropped furthest in importance (down 36.6%) at post-implementation.

Table 12

Total Scores, Rankings and % Change: Pre and Post Implementers (n=37)

	SQ	KS	RS	TM	PT	RI	CM	LD
Total Score Pre	221	308	295	271	164	304	221	288
Ranking	6	1	3	5	8	2	6	4
Total Score Post	228	283	305	287	104	236	320	309
Ranking	7	5	3	4	8	6	1	2
% Change in Scores	3.2	-8.1	3.4	5.9	-36.6	-22.4	44.8	7.3

Note. 1=Highest Ranking, 8=Lowest Ranking

Figure 3. Total Scores: Pre and Post Implementers (n=37)

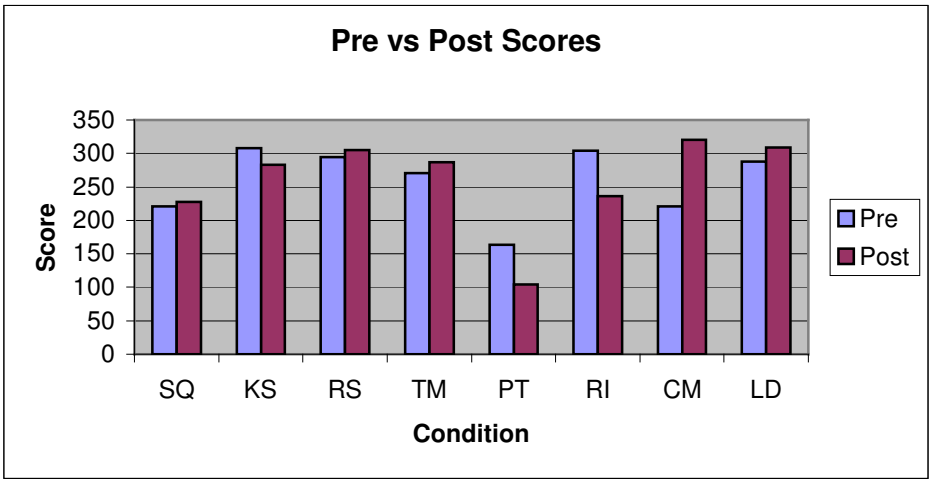
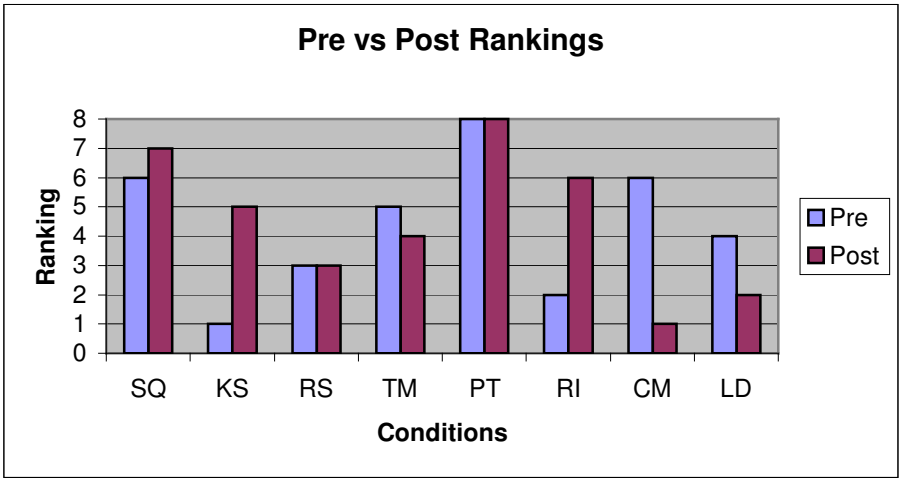


Figure 4. Pre versus Post Implementer Rankings (n=37).



Most participants changed their views from pre to post implementation. Further evidence of these changing perceptions is found in Table 13, which presents a comparison between the total number of participants scoring a condition 12 or higher on either the pre or post survey, as well as the total number scoring the condition 12 or higher on both the pre and post. Few people scored a specific condition high on both the pre and the post survey. For example, 13 people scored the condition "Commitment" 12 or higher on the post compared with 3 on the pre, and only one person scored it 12 or higher on both pre and post. For any condition, at most only 4 participants scored a condition 12 or higher on both surveys. Status Quo was perceived the most important among conditions during both pre and post-implementers with four participants ranking this condition 12 or higher.

Table 13

Number of Participants Scoring a Condition 12 or Higher

Condition	Pre-survey N=37	Post-survey N=37	Both Pre and Post Survey
Status Quo	5	7	4
Knowledge/Skills	12	6	2
Resources	8	5	3
Time	4	2	0
Participation	3	0	0
Rewards/Incentives	10	3	1
Commitment	3	13	1
Leadership	5	8	2

In addition to the descriptive statistics presented above, two factor analyses were conducted. A pre-survey factor analysis for this group of 37 respondents yielded four factors accounting for 79.56% of the variance (Table 14). Factor loadings ranged from -.984 to .890.

Conditions loading on the first factor were Resources and Rewards/Incentives (21.46%). Conditions loading on the remaining three factors were: Knowledge/Skills and Participation (21.43%), Time and Commitment (20.98%), and Status Quo (15.68%). Leadership loaded on two factors and was consequently not considered to load significantly on any factor.

Table 14

Factor Loadings (79.56 % of Variance) for Pre-implementation Conditions (n=37)

Conditions	Factors			
	21.46%	21.43%	20.98%	15.68%
Status Quo	-.066	-.021	.040	-.984
Knowledge/Skills	.159	.797	-.237	.234
Resources	.890	-.172	-.093	.133
Time	.028	.124	-.875	.196
Participation	.076	-.751	.115	.149
Rewards/Incentives	-.909	-.132	-.084	.018
Commitment	.147	-.317	.718	.389
Leadership	-.200	.595	.557	-.049

The post-survey factors represented 80.85% of the variance (Table 15). The magnitude of the factor loadings were slightly lower ranging from -.920 to .849 compared to pre-implementation. Knowledge/Skills, Commitment and Leadership loaded on the first factor for these post-implementers explaining most of the variance (27.58%). Status Quo and Resources (21.94%) loaded on the second factor while Participation (16.41%) and Rewards and Incentives (15.21%) comprise the final two factors. The factor loadings revealed that Time loaded on two factors, and was therefore not considered significant for a single factor.

Table 15

Factor Loadings (80.85 % of Variance) for Post-implementation Conditions (n=37)

Conditions	Factors			
	27.58%	21.64%	16.41%	15.21%
Status Quo	.201	-.897	.195	-.005
Knowledge/Skills	.836	.110	-.112	-.020
Resources	.283	.849	.073	.079
Time	.374	.154	.452	.656
Participation	.169	.103	-.920	.086
Rewards/Incentives	.278	.006	.241	-.873
Commitment	-.787	.314	-.214	.013
Leadership	-.722	-.248	.320	.099

CHAPTER 5: DISCUSSION AND CONCLUSIONS

This descriptive study investigated perceptions of the importance of Ely's conditions with respect to the diffusion of innovation. Although the study was structured around three specific research questions, it was not intended to provide generalizable answers to those questions. Instead, seeking answers to the research questions was meant to produce worthwhile information for future researchers as they pursue a better understanding of diffusion of innovation through the use of Ely's conditions.

The process of answering the research questions for this study produced several noteworthy findings relative to the diffusion of a real-world innovation. These findings include the following observations.

When viewed from a group perspective, the perceptions of pre-implementation groups (adopters) regarding the relative importance of Ely's conditions differ from the perceptions of post-implementation groups (implementers). These differences exist when the pre and post-implementation groups consist of different members or when the two groups consist of identical members.

Individual perceptions regarding Ely's conditions change as innovation adopters progress from being pre-implementers to post-implementers. From an individual perspective, conditions that are perceived as being most important before an innovation is implemented are seldom the same as the conditions that are perceived as being most important after the innovation has been implemented. Although some of these changes are relatively minor, other changes are substantial.

Care should be exercised when interpreting the results of studies dealing with perceptions of the importance of Ely's conditions. As this study demonstrated, multiple approaches, ranging from descriptive statistics to factor analysis, are used to determine the importance of the conditions and within each approach there are numerous variations that can be employed. For example, the literature review for this study determined that the use of ordinal rankings is quite common. Unfortunately, ordinal rankings often convey an illusion of equal differences among rankings, i.e., the difference between 1 and 2 is the same as the difference between 2 and 3 or 7 and 8. The results of this study clearly demonstrated that differences among rankings are often anything but equal. Although it is possible to produce ordinal rankings of the eight conditions, this study suggests that creating clusters of conditions that are approximately equivalent in rank yields more meaningful representations of the perceived importance of the conditions.

Because perceptions of the importance of Ely's conditions change as the diffusion process moves from pre to post-implementation, applying a single, common set of perceptions to both stages of the diffusion of innovation process is problematic and could lead to erroneous conclusions. Instead, when analyzing pre and post-implementation phenomena involving the diffusion of an innovation, the analysis should reflect the differing perceptions associated with the relevant implementation stage.

The findings and conclusions of this study differ in meaningful ways from the findings of several other studies involving perceptions of Ely's conditions. To understand the possible reasons for these differences, it is important to consider factors that could account for these conflicts. Although these other studies were similar to this study in some respects, they did contain important differences. For example, the other studies often involved only one stage, pre or post, of implementation rather than exploring both stages, as was done in this study. The fact that this study was based on the diffusion of a real innovation while some earlier studies involved hypothetical innovations constitutes another major difference. Some studies also differed in context, investigating only pre-implementers' perspectives within a hypothetical context as opposed to this study's investigation of a real context where both pre and post perspectives were compared. Also, the means of eliciting perceptions differed among studies. The current study employed the IPI survey while some prior studies employed scenario-based questions and other approaches to determine perceptions.

Comparison with Prior Studies

Although there are substantial differences between the current study and prior research, the current study did employ some techniques similar to those used in research conducted by Ensminger and Surry as they and their colleagues investigated the perceived importance of Ely's conditions. These similar techniques included use of the IPI survey with pre-implementation participants and conducting factor analyses to identify possible relationships among participant perceptions. A brief discussion of the prior studies is presented below, followed by a discussion of the implications of the findings of the current study relative to these and other prior studies.

Ensminger and Surry were involved in multiple pre-implementation studies related to Ely's conditions. In one study, Ensminger, Surry and Miller (2003) asked faculty (N=56) to rate the importance of Ely's conditions from the perspective of a hypothetical online education program, assessing what conditions were important when implementing such a program. Utilizing scenario-based questions as opposed to the IPI, one question for each of the eight conditions was composed and presented in the survey. Participant rankings based on descriptive statistics showed that Resources, Participation, and Rewards/Incentives were the three most important conditions respectively, a finding inconsistent with the pre-implementation perceptions in the current study. Knowledge/Skills, Rewards/Incentives, and Resources were the three most important conditions in this researcher's study for pre-implementers and Participation consistently ranked last among pre-implementers (N=37).

A second study by Ensminger, Surry, Porter, and Wright (2004) employed the IPI to assess adopters' (N=179) perceptions from a pre-implementation perspective. A hypothetical context and innovation was again the framework for assessment by the participants in their study. A particular innovation was employed as a means of generating adopter profiles that could be used to assess perceptions of which factors were most important in affecting implementation. Using analyses based on descriptive statistics, their results revealed that Resources and Participation ranked as the most important conditions for the total sample, while Leadership and Commitment ranked as the least important. In addition to the use of descriptive statistics, Ensminger et al. (2004) employed factor analysis to uncover underlying factors that could more precisely explain relationships among the conditions. The factor analysis conducted

for a pre-implementation group uncovered Commitment and Leadership as dominant factor loadings. As in their prior study, the results are inconsistent with the current study.

Although Ensminger, Surry, Porter and Wright (2004) focused on pre-implementation studies, other studies investigated the importance and existence of Ely's conditions using post-implementation analyses with real innovations. Because these studies attempted to detect the presence of the conditions and did not attempt to determine their importance (Haryono, 1990; Bauder, 1993; Jeffrey, 1993; Riley, 1995; Ravitz, 1999), ordinal rankings were not generated.

Table 16 presents a comparison of the ordinal rankings from the two Ensminger studies with the results of the current study. The table also compares groupings based on a factor analysis from Ensminger's 2004 study with factor analyses of pre and post-implementers in the current study.

Table 16

Comparison of Condition Rankings and Groupings

Condition	SQ	KS	RS	TM	PT	RI	CM	LD
Ensminger Study 1: Pre-implementation, hypothetical innovation, scenario-based questions, descriptive statistics, N=56	8	4	1	6	2	3	5	7
Ensminger Study 2: Pre-implementation, hypothetical innovation, IPI-based questions, descriptive statistics, N=179	5	3	1	6	2	4	8	7
Current study: Pre-implementation, real innovation, IPI-based questions, descriptive statistics, N=37	6	1	3	5	8	2	6	4
Ensminger Study 2: Pre-implementation, hypothetical innovation, IPI-based questions, factor analyses, N=179	NA	2	4	2	2	3	1	1
Current study: Pre-implementation, real innovation, IPI-based questions, factor analysis, Pre N=37	4	2	1	3	2	1	3	NA
Current study: Post-implementation, real innovation, IPI-based questions, descriptive statistics, N=37	7	5	3	4	8	6	1	2
Current study: Post-implementation, real innovation, IPI-based questions, factor analysis, N=37	2	1	2	NA	3	4	1	1

Note. Rankings range from 1-8 where 1 denotes the most important condition.

Interpreting Perceptions of Importance

It was not this descriptive study's purpose to identify the ideal manner of expressing differences in perceptions of importance. At the same time, it became apparent while analyzing data from the study that some approaches to expressing differences worked better than others and that some comparisons were more illuminating than others. For example, as with many prior studies, ordinal rankings were used in this study to provide one indicator of the perceived importance of Ely's conditions. However, data resulting from this study clearly demonstrated that these simple ordinal rankings provided an incomplete view of perceptions of overall importance. Although such rankings allowed a reader to determine if one condition was more or less important than any other condition, they did not give any indication of the degree of difference in perceived importance from one condition to another. This shortcoming could lead to problems when attempting to interpret the meaning of differences in perceived importance. The analysis of the data from the current study led to the following observations that are useful in interpreting perceptions of importance, both in this study and in similar studies. Ordinal rankings provide a convenient, but incomplete, means of stating differences in perceptions, both within an implementation stage and between pre and post-implementation stages. An analysis and comparison of total scores provide a more in-depth view of perceptions and the relative importance of the conditions than do ordinal rankings. For example, in Table 17, the difference between the first and second ranked conditions in the pre-implementation stage amounted to four points out of 300+ total points, while the difference between the seventh (shown as 6 in the table because scores for ranks 6 and 7 tied) and eighth ranked conditions amounted to 57 points. In the post-implementation stage, the corresponding point differences were 11 points between the first and second place rankings and 124 points between the seventh and eighth place rankings.

Stability in ranking positions may or may not equate to stability in overall importance. Resources was ranked third in both stages while its total points increased by 10 points from the pre to post-implementation stages. Participation ranked eighth in both stages yet its point total decreased by 64 points from the pre to post-implementation stages. The results based on total points indicate that one condition increased in overall importance while the other decreased, even though both conditions' ordinal rankings remained stable.

Substantial changes in ranking positions do not always translate to substantial changes in overall importance. Knowledge/Skills dropped four positions in ranking from pre to post-implementation stages, yet its total score dropped by 25 points, or 8.1 percent. Rewards and Incentives dropped the same number of places but its total score fell by 68 points, or 22.4 percent.

Scores indexed relative to minimum or maximum point totals provide more information regarding perceived importance than ordinal rankings. Scores indexed on the minimum point total for the pre-implementation stage in Table 17 show the most important condition is perceived to be 1.88 times more important than the least important condition. The same index for the post-implementation stage shows the most important condition is perceived to be 3.08 times more important than the least important condition in the post-implementation stage.

Ranking by index-based clusters may provide a more meaningful indication of relative

importance than traditional ordinal rankings. The index-based clusters in Table 17 were based on differential ranges of .05 on the maximum indexed scores. When the pre-implementation stage is viewed from this perspective, three conditions are considered equivalent and of greatest importance, one condition rates second, one condition rates third, two conditions share fourth, and one condition rates fifth.

Table 17

Methods of Presenting Perceived Importance of Conditions

		Condition							
Ranking method		SQ	KS	RS	TM	PT	RI	CM	LD
	Pre-implementation, total scores, N=37	221	308	295	271	164	304	221	288
	Pre-implementation, ordinal rankings, N=37	6	1	3	5	8	2	6	4
	Pre-implementation, indexed scores based on minimum, N=37	1.35	1.88	1.80	1.65	1.00	1.85	1.35	1.76
	Pre-implementation, indexed scores based on maximum, N=37	.72	1.00	.96	.88	.53	.99	.72	.94
	Pre-implementation, indexed based clusters, N=37	4	1	1	3	5	1	4	2
	Pre-implementation, factor analysis, N=37	4	2	1	3	2	1	3	DNL
	Post-implementation, total scores, N=37	228	283	305	287	104	236	320	309
	Post-implementation, ordinal rankings, N=37	7	5	3	4	8	6	1	2
	Post-implementation, indexed scores based on minimum, N=37	2.19	2.72	2.93	2.76	1.00	2.27	3.08	2.97
	Post-implementation, indexed scores based on maximum, N=37	.71	.88	.95	.90	.33	.74	1.00	.97
	Post-implementation, indexed based clusters, N=37	3	2	1	2	4	3	1	1
	Post-implementation, factor analysis, N=37	2	1	2	DNL	3	4	1	1

Darlington (1997) explains cluster versus factor analysis as uncovering factors that differentiate conditions versus factors that underlie the conditions respectively. He states that factor analysis has the ability to evaluate correlation properties and inverse relationships unlike cluster analysis. Any groupings within cluster analysis are referred to as generic "similarity measures" rather than correlations. These limitations notwithstanding, the indexed-based clusters produced groupings or factors that differed in comparison to factor loadings generated through factor analysis. Pre-implementation cluster analysis produced five factors, while post-implementation produced four factors. Using .05 as the differential range for cluster analysis, results revealed that those particular grouped conditions were too similar to differentiate.

In the current study, both factor and cluster analysis uncovered other relationships, differences and similarities between perceptions of importance relative to the conditions. These relationships derived from factor or cluster analysis suggest that the conditions are present and are important in implementation regardless of stage. These relationships do not reflect the degree of relative importance; however, the interrelated conditions obtained through factor or cluster analysis may suggest the existence of other conditions yet to be identified.

Literature Relevant to Findings

This study demonstrated that members of adopter groups differ within stages of implementation and that individual adopters change across stages of innovation. These observations are supported, and partially explained, by the diffusion of innovation literature.

The observation that a person's "implementation profile", in terms of the degree of importance one places on Ely's conditions, may not be consistent over time and may vary depending on the individual's and organization's stage of implementation, is supported in the literature review presented earlier in this document. Adopter perspectives can be influenced by their stage of concern or awareness (Askar & Usluel, 2001; Hall & Hord, 1987), and experience and knowledge (Bruer, 1994; Cloutier, 2001; Dooley, 1999; Ravitz, 1999; Sherry et al., 2000).

Perceptions are also influenced by the level of use of the technology (Dooley, 1999) and whether the technology is undergoing implementation or has been institutionalized (Rogers, 1995). With regard to these factors, it is evident that the innovation in this study was undergoing continued implementation during the course of the study. The innovator's director of technology noted the unanticipated complexity and time required to develop and adapt the tool for their needs and interface with existing processes. He also indicated there was insufficient manpower to implement every facet of the development process and move all adopters to the tool at the same rate.

Perceptions also change with experience. Experience with the technology ensures that user perceptions go beyond the surface features of the innovation (Bruer, 1994; Lewis & Orton, 2001; Ravitz, 1999; Sherry et al., 2000). During pre-implementation, responses suggest that employees perceive those conditions that are more directly related to their position and context within the company as important factors for their implementation. This is evident in surface features such as rewards and incentives and skills and knowledge, conditions that dominated the perceptions of pre-implementers in this study.

Responses during post-implementation suggest that adopters became more attuned to the complexity, problems and broader issues of implementation over time. Conditions such as leadership and commitment are identified as being more important among these adopters during post-implementation; however, conditions related to knowledge/skills follow closely as key conditions. The continued concern for knowledge/skills in the current study may be explained in part by the ongoing implementation process within the organization. Burton and Danielson (1999) also attribute the continued importance of knowledge/skills to more complex uses of the technology over time; as adopters become more experienced with the technology they demand more advanced training and additional support.

Implications for Future Research

Several recommendations for future research emerged from the conduct and conclusions of this study. The recommendations and their rationales are presented below.

The results of this study were difficult to compare with most prior studies because different instruments and procedures were used to collect data. Development and use of a commonly agreed upon instrument would facilitate comparison of results of future studies.

The current study uncovered relationships between several of Ely's conditions. These relationships were identified by clustering equivalent values based on descriptive statistics and by conducting factor analyses. Additional research is needed to determine if these related conditions comprise one or more entirely new conditions or if they are distinct conditions that are nearly equal in perceived importance.

Comparisons between the results of the current study and the results of prior studies gleaned from the literature suggest perceptions differ between real-world and hypothetical innovations and contexts. There currently is a shortage of studies of the perceived importance of Ely's conditions conducted in real-world contexts with real innovations. To maximize the transferability of the results, additional studies involving real innovations and contexts are needed.

The study demonstrated that an adopter's implementation profile score is likely to change as the adopter moves from being a pre-implementer to a post-implementer. The current study did not address the question of why these changes occur. Assuming an understanding of the factors causing these changes is important, further research is needed to determine why these changes occur.

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APPENDIX A: FACILITATING CONDITIONS OF INSTRUCTIONAL TECHNOLOGY INNOVATIONS

Condition	**Description**
Accessibility	Accessibility of information (Glener, 1996); accessibility and ease of distribution (Kearsley, 1996); physical accessibility: onsite/remote (Romiszowksi, 1997); expectancy among students toward information access (Barone & Hagner, 2001).
Adaptability	Ability to adapt the innovation to instructional needs; broad applications (Ely, 1990b; Rogers, 1995)
Assessment & Evaluation	Bauder, 1993; Ensminger, 2001; Hartman & Truman-Davis, 2001; Kerrey et al 2000; Reigeluth, 2002; Ravitz, 1999; Surry & Ensminger, 2002; assessment of the environment (Ely, 1999) assessment of the role of the instructor (Kearsly, 1983); assessment of learner preferences, factors that change behavior, and innovation attributes (Lewis & Orton, 2001); assessment of technology integration in teaching and learning (Byrom, 1998; Byrom et al. 2000); assessment of faculty perceptions (Bober, 2002; Buttolph, 1992; Cuban, 1988; Dooley, 1999)
Benefits	Time invested returns benefits of increased instructional/classroom time; centralization of information (Cohen, 1997; Ansorge & Cooley, 2001); observable results (Rogers, 1995); benefits to ensure progression through stages of implementation (Carter, 1998); Goldstein, 2001; Moore, 1999.
Compatibility	Easily integrated with current infrastructures/hardware/software, instruction and existing knowledge/skills (Rogers, 1995; Ely, 1995; Moore, 1999)
Capacity & Competency	Assessing the teaching and learning capacity to ensure student achievement; defining and evaluating institutional success through a quality assessment of achievement and outcomes based upon student competencies and certifications; a move from assessing inputs to outcomes (Barone and Hanger, 2001); addressing the limited capacity of textbooks and current curricula to accommodate expanding knowledge (NASBE, 2001);
Choices	Identifying direction by linking institutional goals, purpose and infrastructure, and identifying consequences (Barone and Hanger, 2001); acquiring the necessary knowledgebase and experience to fully understand choices available (Cloutier, 2001; Dooley, 1999; Lewis and Orton, 2000; Ravitz, 1999)
Courage	Visible and focused leadership through their direct

	confrontation of problems; resources and support from those at the top of administration (Barone and Hanger, 2001)
Communication	Communication to establish an atmosphere of trust; involving all stakeholders (Barone and Hanger, 2001); Schorger, 1997; Jacobsen, 1998; communication among faculty (Dooley, 1999) established through Teaching, Learning Round Tables (TLRT) (Erhmann, 2001); communication channels between adopter groups as an element in diffusion of the innovation (Rogers, 1995).
Community	A community of networked faculty supported by technology from across disciplines for the purpose of sharing information and cooperative interaction (Barone and Hanger, 2001); understanding the context and system (community) within which change is to occur (Ellsworth, 2000); communication technologies are dependent upon a "critical mass" or community of users (Harris, 1994; Rogers, 1995).
Complexity and Confusion	Overcoming and adapting to complexity through flexible governance practices (Barone and Hanger, 2001); complexity of the innovation in terms of use influences adoption (Rogers, 1995); complexity of innovation use increases need for experienced support staff (Burton & Danielson, 1999).
Consistency	Providing consistent support systems and practices through standardization in software, hardware, and pedagogy to ensure leadership does not go astray (Barone and Hanger, 2001)
Cooperation & Collaboration	Changes in infrastructure require cooperation accomplished through support via a team approach from stakeholders (faculty and administration) thereby ensuring a sense of ownership (Barone and Hanger, 2001); collaboration and cooperation in identifying and involving stakeholders toward adopting the philosophy and understanding the culture of the organization (Ehrmann, 2001; Boone, 1992; Jacobsen, 1997)
Creativity	A need for creative strategies that link values, culture, institutional philosophy and context to all conditions to be addressed for transformation (Barone and Hanger, 2001)
Critical Mass	Existence of a large user base; a "community of users" encouraging and sustaining use (Rogers, 1995; Gbomita, 1997; Cloutier, 2001; Braa & Sorgaard, 1997)
Culture & Context	Acknowledging faults from an industrial age and adapting new processes in an information age to the existing institutional culture and context (Barone & Hanger, 2001); Boone, 1992; Christenson, 1999; Deif-Ayoub,

	1997; Dooley, 1999; Dove & Fisher, 1999; Ely,1990; Ehrmann, 2001; Green & Gilbert, 1995; Jacobsen, 1997; McMaster, Vigen & Wastell, 1997; Moore, 1998; Purkey & Smith, 1983; Rogers, 1995;; Tatnall, 2001; selecting a CMS (software) that integrates best with the culture of the institution (Goldstein, in Boettcher et al., 2001).
Curriculum	Re-conceptualizing the curriculum by addressing linkages between infrastructure, institutional goals and culture, and faculty roles in transformation assisted by technical and pedagogical support (Barone and Hanger, 2001); curriculum in technology oriented programs moving from development and application of technology, to the transfer and diffusion of technology, and user adoption (Johnson, Gatz and Hicks, 1997); acknowledging the limited capacity of textbooks and current curriculums to accommodate expanding knowledge bases (NASBE, 2001); developing a curriculum with a focus on student-centered vs. teacher-centered instruction (Stuhlmann, 1997); teachers moving through stages of implementation which require the developing relationships between the technology and curriculum (Sherry, Billig, Tavalin & Gibson, 2000); moving staff-development from technology training to a focus more on curriculum development and technology integration where technology is a supportive tool for instruction providing new and enlightening learning experiences (Byrom et al, 2000)
Ease of Use and Simplification	Easily adapted, integrated and utilized to meet instructional needs (Boettcher et al., 2001; Neubarth, 1997; Rogers, 1995; Stuhlmann, 1997)
Encouragement	Encouragement from colleagues, change agents, or stakeholder groups to use the product/innovation (Ensminger, 2001; Rogers, 1995)
Environment	The technology is conducive to the current context (Dooley, 1999; Dove & Fisher, 1999; Ely, 1978, 1990; Noblitt, 1997; Plotnick, 1997; Allen, 2002)
Flexibility	Flexibility in access, delivery/presentation, and communication modes (Ansorage & Cooley, 2001; Croft, 1996; Harris, 1994; Rogers, 1995; Young, 2001b)
Funding	Funding for incentives, and infrastructures (support, network, hardware/software) (Ellsworth, 1997; as a component of resources: Ely, 1990b)
Infrastructure	Established infrastructures including support (i.e. faculty training programs), network and hardware resource infrastructures (Barone & Hanger, 2001; Berge & Muinlenburg, 2001; Boettcher et al., 2001; Burton &

	Danielson, 1999; Carman, 1999; Carter, 1998; Charlton et al., 1997; Ellsworth, 1997; Ely, 1990b; Hartman & Truman-Davis, 2001; Harris, 1994; Head & Moore, 1999; Katz, 2002; Noblitt, 1997; Stuhlman, 1997).
Marketing	Efforts that inform users of developments, benefits, and potential thereby encouraging continued use (Boone, 1992)
Modifiable	Ability to modify content easily and quickly to solve a wide range of problems (Ely, 1990b; Glener, 1996; Rogers, 1995,)
Observable Results	Visible benefits and success with the product/innovation personally or within the institution (Moore, 1999; Rogers, 1995)
Planning	Strategies for issues surrounding the innovation's ability to address issues beyond those of task management to organizational factors, and original project goals and objectives (Boone, 1992; Cradler, 2000; Dooley, 1999; Green & Gilbert, 1995; Reigeluth, 2002; Saettler, 1990; Snelbecker et al., 2001)
Policy	A clear policy agenda from leadership from various levels that dictates product/innovation use and technology trends (Barone & Hanger, 2001; Katz, 2002; NASBE, 2001)
Relative Advantage	The product/innovation is better than previous, existing or other means in terms of its designed purpose (Croft, 1996; Glener, 1996; Green & Gilbert, 1995; Hooper, 2001; Kruse, 1997; Rogers, 1995)
Standardization	A belief that the innovation has been standardized (standardized toolsets) and is easily integrated and compatible with standard application software and external modules (browsers, web-development tools, etc.); (Barone & Hagner, 2001; Boettcher et al., 2001; Charlton, Gittings, Leng, Little, & Neilson, 1997; Crossman, 1997; Curtin, 1997)
Support	Support from change agents, administrative/technical support, mentors, and support form colleagues (Barone & Hagner, 2001; Burton & Danielson, 1998; Carter, 1998; Ely, 1990b; Jacobsen, 1998; Dooley, 1999; Harris, 1994; Leggett & Persichitte, 1998)
Trust	A sense of trust among users/colleagues, change agents and leadership with respect to the product's use; benefits and place in education (Barone & Hagner, 2001; Ely, 1999; Haab, M., Surry, D.W. Stout, C. Hall, D.A.T., Hall, 2004; Moore, 1999)

Note. The table conations additional conditions as identified through an extensive review of the literature.

APPENDIX B: SURVEY INSTRUMENT

Pre-implementation Instruction Screen

Thank you for your participation in this research questionnaire.

You have been identified by [your firm's] implementation team as an adopter of [the product management software]. The questionnaire is designed to investigate the relative importance of conditions that facilitate the implementation of technologies.

The survey contains a short set of demographic questions followed by 56 statements. The entire questionnaire should take approximately 12-15 minutes to complete. You will be asked to complete a follow-up survey within 6-8 weeks. This survey has been approved by the Institutional Review Board of Virginia Polytechnic and State University to ensure compliance with proper research standards. Any information related to your personal identity that is collected will be viewed only by the researcher and will be destroyed following such review. Therefore, all responses to the survey will be completely anonymous. Your participation in this questionnaire is voluntary.

Please consider the following when taking the survey:

- Don't spend too much time when responding to the questions - don't try to analyze the questions in great detail - it's best if you just read each question and go with your initial "gut reaction"
- Some of the questions might seem confusing or redundant and sometimes you might want to pick both options, or neither option - that's okay, the survey is designed that way - just make a selection and move on to the next question

Questions, comments or problems regarding this survey, please email: jebrown4@vt.edu

If you have read and understand the information stated above, and if you consent to participate in this research, please click on the link below to begin the questionnaire.

Begin Questionnaire

Please enter your employee e-mail address (this information will remain confidential and is only for unique identification)

[ ]@[firmname].com Reenter to verify: [ ]@[firmname].com

Sign In

Survey Questionnaire

In which of the following age groups are you?

20 years or younger
21-25
26-30
31-35
36-40
41-45
46-50
51-55
56-60

61 years or older
prefer not to say

What is your gender?

- Female
- Male

Enter the state where you are currently employed by [this firm**].**

Which title most closely matches you current job?

General Manager
Product Design
Operations
Technical Support
Program Manager
Department Manager
Product Line Manager

Which is the highest educational degree you have received to date?

High School Diploma or Equivalent
Associates Degree
Undergraduate College Degree
Master's Degree
Doctoral or Professional Degree
Other
Prefer not to say

In general, how would you describe your overall ability to use "technology", computers, audio/video equipment, and other "gadgets"?

Very Low
Low
Average
High
Very High
Prefer not to say

Have you used ProjectLink?

- ☐ Yes
- ☐ No
- ☐ Don't know

Have you used [this product management software]**?**

- ☐ Yes
- ☐ No
- ☐ Don't know

Have you used, or are you currently using, a product or project management software application other than [the software currently being implemented]**?**

- ☐ Yes
- ☐ No
- ☐ Don't know

Next >

In this section, think about your organization's change to [this software]. We would like to know what would make you more likely to go along with the change. For each question, please select the one response that best fits you. In some instances, you may wish to select both responses, but you will have to select one or the other. Do not spend too long thinking about each question; go with your first choice or "gut" reaction. You will not be allowed to change your answer or navigate back to review your responses once you proceed to the next question.

Next >

Intro Question ID	Intro Question	Options
8	Have you used [this software]?	Yes,No,Don't know
10	In general, how would you describe your overall ability to use [this software].	Very Low,Low,Average,High,Very High

Question Stem ID	Question Stem
1 (Pre-implementation)	I would be more likely to change to [this software] if:
2 (Post-Implementation)	I am changing to [this software] because:

Pre-implementation

Response Option ID	Question Stem ID	Response Option	Option Set	Condition
1	1	I disliked the current product management system	1	Status Quo
2	1	I felt confident in my ability to use it	1	Skills
3	1	I will have access to it whenever I needed to use it	1	Resources
4	1	I could learn about it over a period of time during my normal work hours	1	Time
5	1	I were included in the decision making about it	1	Participation
6	1	I would receive some personal benefit from using it	1	Rewards

7	1	Upper management is really committed to it	1	Commitment
8	1	My immediate supervisor facilitates and encourages my use of it	1	Leadership
9	1	The current product management system wasn't effective	2	Status Quo
10	1	I had the skills and knowledge to use it	2	Skills
11	1	Everything needed to set up and use it is available	2	Resources
12	1	The company gives me time away from my normal duties to learn about it	2	Time
13	1	My ideas and opinions about it were sought out and valued	2	Participation
14	1	Rewards and incentives for using it were meaningful and valuable to me	2	Rewards
15	1	Upper management is visibly and actively supportive of it	2	Commitment
16	1	My immediate supervisor is actively supportive of it	2	Leadership

Post Implementation

Response Option ID	Question Stem ID	Response Option	Option Set	Condition
1	2	I disliked the previous product management system	1	Status Quo
2	2	I felt confident in my ability to use it	1	Skills
3	2	I had access to it whenever I needed to use it	1	Resources
4	2	I could learn about it over a period of time during my normal work hours	1	Time
5	2	I was included in the decision making about it	1	Participation
6	2	I received some personal benefit from using it	1	Rewards
7	2	Upper management was really committed to it	1	Commitment
8	2	My immediate supervisor facilitated and encouraged my use of it	1	Leadership
9	2	The previous product management system wasn't effective	2	Status Quo
10	2	I had the skills and knowledge to use it	2	Skills
11	2	Everything needed to set up and use it was available	2	Resources
12	2	The company gave me time away from my normal duties to learn about it	2	Time
13	2	My ideas and opinions about it were sought out and valued	2	Participation
14	2	Rewards and incentives for using it were meaningful and valuable to me	2	Rewards
15	2	Upper management was visibly and actively supportive of it	2	Commitment
16	2	My immediate supervisor was actively supportive of it	2	Leadership

Post-implementation Survey Instruction Screen

Thank you for your participation in the final phase of this research questionnaire. The survey, consisting of 56 statements, is similar to the first. It is designed to investigate the relative importance of conditions that facilitate the implementation of technologies, in this case, your perspective of these conditions after the implementation of [the product management software].

The questionnaire should take approximately 12-15 minutes to complete. This survey has been approved by the Institutional Review Board of Virginia Polytechnic and State University to ensure compliance with proper research standards. Any information related to your personal identity that is collected will be viewed only by the researcher and will be destroyed following such review. Therefore, all responses to the survey will be completely anonymous. Your participation in this questionnaire is voluntary.

Please consider the following when taking the survey:

- Don't spend too much time when responding to the questions - don't try to analyze the questions in great detail - it's best if you just read each question and go with your initial "gut reaction"
- Some of the questions might seem confusing or redundant and sometimes you might want to pick both options, or neither option - that's okay, the survey is designed that way - just make a selection and move on to the next question

Questions, comments or problems regarding this survey, please email: jebrown4@vt.edu

If you have read and understand the information stated above, and if you consent to participate in this research, please click on the link below to begin the questionnaire.

APPENDIX C: INFORMED CONSENT FORM

Dear Mr. Brown,

I am a graduate student at Virginia Polytechnic and State University in the Instructional Technology department. I am conducting a research study to investigate the relative importance of conditions that facilitate the implementation of technologies. I am requesting your permission to gain access to employees, specifically adopters of [the product management software] at [your firm] for an online research survey. The survey contains a short set of demographic questions followed by 56 statements. The entire questionnaire should take approximately 12-15 minutes to complete. Participants will be asked to complete a similar follow-up survey within 6-8 weeks.

This survey meets the requirements of the Institutional Review Board of Virginia Polytechnic and State University to ensure compliance with proper research standards. Any information related to personal identity that is collected will be viewed only by the researcher and will be destroyed following such review. Therefore, all responses to the survey will be completely anonymous.

Your consent to provide access to employees for this study is voluntary. By providing such consent, you will help researchers gain a greater understanding of this topic. If you have any questions concerning this study, please call me at (540) 961-0729 or email me at jebrown4@vt.edu.

Sincerely,

Jeff Brown
Virginia Polytechnic and State University

I give consent for employee access as described in the above study.

_____
Name (print)/Title

_____
Signature

_____
Date

APPENDIX D: IRB EXEMPT APPROVAL

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Institutional Review Board

Dr. David M. Moore
IRB (Human Subjects)Chair
Assistant Vice President for Research Compliance
CVM Phase II- Duckpond Dr., Blacksburg, VA 24061-0442
Office: 540/231-4991; FAX: 540/231-6033
email: moored@vt.edu

DATE: January 26, 2005

MEMORANDUM

TO: Kenneth R. Potter Teaching and Learning 0313
Jeffrey Brown EDCI

FROM: David Moore

SUBJECT: **IRB Exempt Approval:** "Perceptions of the Relative Importance of Conditions that Facilitate Implementation: An Investigation of Pre and Post-Implementation"
IRB # 05-045

I have reviewed your request to the IRB for exemption for the above referenced project. I concur that the research falls within the exempt status. Approval is granted effective as of January 26, 2005.

Virginia Tech has an approved Federal Wide Assurance (FWA00000572, exp. 7/20/07) on file with OHRP, and its IRB Registration Number is IRB00000667.