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ABSTRACT

Chief information officers (CIOs) have a unique role in today's dynamic and competitive business environment. They must deal with the impacts of external environmental changes, changing internal customer needs, and rapidly changing technology. New models for the organization suggest that CIOs should create and manage an enterprise IT organization that is more flexible to manage uncertainty. During a two-year ethnographic study, the lead researcher observed and interviewed CIOs to determine current CIO practices for managing uncertainty. Findings from the study also include CIO recommendations on how enterprise IT organizational flexibility can help to balance the need for lean and effective operations with the need for creative and innovative ones. This paper reports on one aspect of the study: CIO leadership. The findings suggest that a CIO's ability to be flexible is critical if the enterprise IT organization is to deal with and manage uncertainty. Flexible CIOs, it was found, respond to three types of *environmental uncertainty* (global, enterprise, and IT), and do so by three means of flexibility response – anticipation, agility, and adaptation. Flexible CIOs who are proactive to unexpected change manage uncertainty as if it were an *opportunity*.

Keywords

IT organizational flexibility, dynamic business environments, CIO leadership, uncertainty, IT governance, socio-technical systems, ethnographic research method

INTRODUCTION

Chief Information officers (CIOs) lead today's enterprise information technology (IT) organizations in an uncertain and dynamic competitive business environment. CIOs must deal with external environmental changes, changing internal customer needs, and with rapidly changing technology. Business literature abounds with articles on organizational change and how to design and lead the *new flexible firm*, but there is little theory on how CIOs manage uncertainty and unexpected change. Studies suggest that enterprise IT leaders should create enterprise IT organizations that are more flexible according to studies on change (Leidner, Beatty, and Mackay, 2003), but the same studies do not define what is meant by flexibility or how to implement flexibility into the enterprise IT organization. Earlier studies on IT flexibility generally focused on sub-components of the enterprise IT organization and its technology: flexible software (Sushil, 2001; Goldman, Nagle, and Preiss, 1995); flexible infrastructure (Ross, 2003; Byrd and Turner, 2000; Duncan, 1995; Knoll and Jarvenpaa, 1994); flexible processes (Meade and Rogers, 1998); and flexible enterprise IT personnel (Byrd, Lewis, and Turner, 2004).

One objective of this two-year exploratory research was to consider the enterprise IT organization as a socio-technical system and identify impacts of dynamic business environments on the *system*. When one component of the enterprise IT organization, such as risk management, is impacted by the dynamic environment, the effects of those changes impact all components of the enterprise IT organization including the people, the technology infrastructure, the customers, and the technology services, products, and applications. For this research, we defined four key enterprise IT organizational components including governance, personnel, technology infrastructure, and technology services, products, and applications. Each of these components was considered integral to the concept of enterprise IT organizational flexibility.

Traditional academic information systems (IS) research uses quantitative research methods such as surveying, experimenting, and statistically analyzing data to study IS issues. However, these methods are not as effective when trying to explore more complex questions, such as those occurring in dynamic business environments, and when the questions are embedded into multiple systems (Patton, 2002; Klein and Myers, 1999). On the other hand, qualitative methods use an inquiry process to understand organizational, social, or human issues (Patton, 2002, Creswell, 1994). The ethnographic descriptive research method used for this study explored key factors associated with the issues and led to findings, which demonstrate unexpected outcomes (Le Compte and Schensul, 1999). We observed the culture of the enterprise IT organization from the perspective of the CIO. Since the lead researcher had previously been a senior IT practitioner, the ethnographic research was considered to be from an emic perspective, where the interpretations were made from an insider's orientation (Bryne, 2001).

This paper reports on one aspect of the study findings - CIO leadership - and the implications for CIOs from a leadership perspective when dealing with uncertainty and unexpected change. The following section of this paper describes the impact of changing business environment on the enterprise IT organization and the research model and questions. The next section discusses the benefits of ethnographic interpretive methods and the research plan for this study. Then, in the next section, the data collection, analysis, and study findings relating to CIO leadership are discussed. The conclusions are given in the last section.

MANAGING UNCERTAINTY IN IT

The IT Role

The enterprise IT organization has evolved from a backroom support function to a strategic business partner in information-intensive enterprises that use information technology to add value to the enterprise and to provide competitive advantages. According to Purser and Passmore (1992), technological, economic, and social change create dynamic business environments, which result in a high degree of unpredictability, leading to environmental *uncertainty* (Scott, 1992; Burns and Stalker, 1961). This environmental uncertainty impacts industries in different ways, requiring enterprise IT organizations to support a range of different business situations from successful market leaders to enterprises struggling to survive. Both competitive and struggling types of enterprises require evolving and innovative IT services, products, and applications to remain or become competitive (Malhorta, 1993). Global organizations also require intense sharing of information to allow cooperation, coordination, and teamwork in partnerships and strategic alliances. This increasing reliance on information technology is changing the way enterprises do business leading to economic and social change. Research studies in business management, engineering, and social sciences have identified different approaches to managing uncertainty and interacting with the environment, including waiting for the uncertain event to happen and then reacting to the event, or, by being more proactive, anticipating and preparing for the uncertainty before it occurs.

Organizational Flexibility

A search of organizational, management, and information systems literature found that the terms *flexibility* and *IT flexibility* are both ambiguous and complex (Sushil, 2001; Volberda, 1998; Knoll and Jarvenpaa, 1994). There is no commonly accepted definition of IT flexibility. A flexible IT network (scalable, services-based architecture) has a different definition than flexible software (mass-customizable). Flexible IT employees are sometimes considered to be mavericks and perceived to be employees who ignore the organization's operational procedures. Others consider flexible IT employees to be ones who recognize opportunities when customers change their business needs and create innovative solutions to business problems. Business literature includes articles on organizational change and how to design and manage the *new flexible firm* (Volberda, 1998), but there is little theory on *enterprise IT organizational flexibility*.

Flexibility has been successfully used within the manufacturing industry and with software development for over twenty years (Sushil, 2001; Goldman, Nagel, and Preiss, 1995). One of the concepts explored in this study was to determine if flexibility theories and knowledge from manufacturing and software development would be adaptable to the enterprise IT organization and could be systematically introduced into the enterprise IT organization. On an abstract system level, flexibility can be seen as "...a system's ability to work in new environments," whether the system is technical or socio-technical (Whitworth, Fjermestad, and Mahinda, 2006). This definition can be broken down into input-processing-output (IPO) components to give three related-attributes - anticipation, agility, and adaptability - each with specific characteristics and attributes that CIOs could use within the enterprise IT organization (Patten, 2004; Patten, Fjermestad, Whitworth, and Mahinda, 2005). We found that flexibility is not so simple that one approach can fit all.

One major IS issues area focuses on the importance of aligning the IT strategy with the enterprise business strategy (Luftman and Kempaiah, 2007). However, in dynamic business environments, alignment once achieved may become out-of-step when unexpected changes occur. Therefore, the enterprise IT organization also needs to prepare for unexpected changes, which Patten (2004) and Patten et al. (2005) referred to as *anticipation*, balancing planning for expected change with preparing for unexpected change. When the unexpected change occurs, the enterprise IT organization must have the capability to be *agile* to respond quickly to identify and leverage the potential opportunity or minimize the potential threat. Finally, the enterprise organization then must be *adaptable*, which is the capability of the organization to self-learn, self-organize, and be self-disciplined based on previous experiences.

Enterprise IT Organization as a Socio-Technical System

Environmental impacts on organizations, such as the enterprise IT organization, should be studied as a socio-technical system (Whitworth, Fjermestad, and Mahinda, 2004; Alter, 1999). Socio-technical organizational systems include operational processes and people, as well as organizational policies and rules. Emergent properties are dependent on the system components and the relationships among the system components. Since the performance of these properties must be evaluated as a whole system, the organizational objectives of a socio-technical system depend on the system as a whole and must consider all aspects and relationships among the components of the system. In other words, a system must be studied in its entirety to fully understand it.

Therefore, when considering the impact of uncertainty and unexpected change on the enterprise IT organization, any changes made within one component of the enterprise IT organization must be balanced throughout the entire organization by evaluating the interactions of the component parts. For this research, we used four key enterprise IT organizational components for the analysis of the impacts: governance, personnel, technology infrastructure, and technology services, products, and applications. Each of these components was considered integral to the concept of enterprise IT organizational flexibility.

Unexpected and Expected Change

As one objective of this study was to understand how CIOs respond to change, it was necessary to categorize the different types of change. As a result of the analysis of the data from the CIO interviews, a logical solution emerged to show how *uncertainty* and *change* related to the CIO of an enterprise IT group. The solution, which emerged during the iterations, was to divide *change* into *expected* and *unexpected*, where only the latter created *uncertainty*. The complex, dynamic environment that impacted the CIO and the enterprise IT organization was also divided into three different areas based on where the business drivers causing expected or unexpected changes originated: the environment external to the enterprise, the environment within the enterprise, but not including the enterprise IT organization, and the environment internal to the enterprise IT organization. Participating CIOs gave examples of the different types of changes, *expected* and *unexpected*, both from the external and in the internal environment as shown in Table 1.

Types of Change	Environmental Sources of Change		
	<i>External to the Enterprise</i>	<i>Within the Enterprise</i>	<i>Within the EITO</i>
UNEXPECTED CHANGE	<ul style="list-style-type: none"> - Globalization impacts - Government regulations - Customer business strategy changes 	<ul style="list-style-type: none"> - Proactive business strategy changes - Mergers & acquisitions 	<ul style="list-style-type: none"> - IT personnel changes - Technology supplier mergers & acquisitions
EXPECTED CHANGE	<ul style="list-style-type: none"> - Customer forecasts 	<ul style="list-style-type: none"> - Internal customer forecasts 	<ul style="list-style-type: none"> - Technology infrastructure changes - Technology compatibility issues

Table 1. Environmental Sources of Change by Type of Change

For example, although the actual future customer business is unknown, forecasts of the external and internal customer needs are regularly made as part of the planning process and are considered *expected* changes. On the other hand, an external customer deciding to change, sell, or acquire a major part of their business may result in *unexpected* changes that

significantly impact the business of the enterprise. Another *unexpected* change could be when a key employee becomes sick or decides to move away.

Research Questions and Model

The goals of this exploratory study were to (1) understand how uncertainty and unexpected change are managed by CIOs, (2) develop a systematic definition for enterprise IT organizational flexibility, and (3) explore how a proposed enterprise IT organizational framework could be used by CIOs to better manage uncertainty and unexpected change. As a result, the primary research question was:

How do CIOs use flexibility to respond to uncertainty and unexpected change within an enterprise IT organization?

Because of the iterative nature of the analysis of the data in this study, the final research model evolved over time as relationships and concepts became clearer. The final version of the research model is shown in Figure 1. Dynamic external and internal business environments contribute the uncertainty and unexpected changes as well as expected changes, which impact the enterprise IT organization (EITO). Combining the three flexibility aspects of anticipation, agility, and adaptability forms the *Enterprise IT Organizational Flexibility Cycle*. The EITO flexibility cycle is activated by environmental unexpected change and affects each of the four major components of the enterprise IT organization. CIOs can plan for expected change, however, CIOs cannot plan for unexpected change. The CIO must deal with the unexpected changes affecting the enterprise IT organization as it moves through the enterprise IT organizational flexibility cycle.

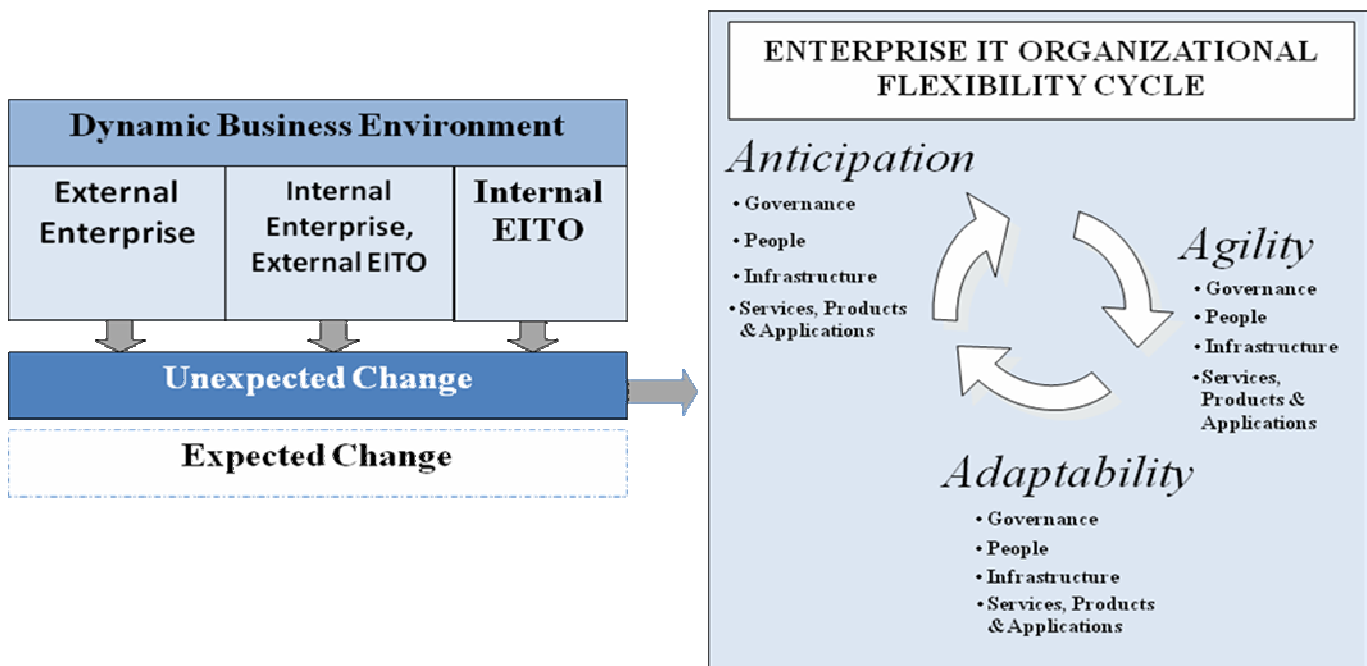


Figure 1. CIO Perspective: Enterprise IT Organizational Flexibility Research Model

INTERPRETIVE RESEARCH METHOD

Qualitative research uses a wide variety of available qualitative data collection techniques. It can be descriptive, used as part of quantitative research design in a mixed-method study, or used to develop quantitative measures for future research (LeCompte and Schensul, 1999). Qualitative research has been used in information systems (IS) research for the last twenty years (Markus and Lee, 1999). Different types of qualitative research provide information systems researchers with an understanding of human thought and action within the context of organizational and social perspectives. It has led to *deep insights* into information systems phenomena such as enterprise information systems management or information systems development (Markus and Lee, 1999).

Ethnographic Research

Ethnographic research does not try to prove answers; it emphasizes discovery by using open-ended questions. This method of investigation allows researchers to gather information about sources of problems from the participants. LeCompte and Schensul (1999) described the difference between basic research, which answers questions that may not have any direct reference to specific problems, and applied research, which focuses on solving human problems. Ethnographic research is, by its nature, applied. Its purpose is to understand socio-cultural problems in various human situations that occur within a community or institution as determined either by the researcher or the involved humans. Its unique approach is intended to solve problems or, at least, bring about positive change in the problem situations. In this study, we observed the culture of the enterprise IT organization from the perspective of the CIO. Since the lead researcher had previously been a senior IT practitioner, the ethnographic research was considered to be from an emic perspective, where the interpretations were made from an insider's orientation (Bryne, 2001).

The problem is first identified, which guides the study. If a problem is perceived to be important by the community, then the community will cooperate with the research (LeCompte and Schensul, 1999). In this study, the problem was how CIOs manage uncertainty in dynamic business environments. As a result, ethnography research method used in this study led to a series of emergent themes that explained how CIOs participating in the study think, believe, and behave (LeCompte and Schensul, 1999). The use of ethnography and in-depth interviews overcome limitations of traditional research methods such as surveying, analyzing data, and experimenting with tests and repeated measures (Rubin and Rubin, 2005). In-depth interviews include careful standards, built-in credibility checks, and a systematic analysis that result in a richness of findings. Statistical summaries are not the same as communicating because numbers do not tell a story that people can understand (Rubin and Rubin, 2005).

Data Analysis

Purposeful sampling was used to select the participants for the semi-structured interviews to insure a broad representation of demographics and *case-selection* procedures (LeCompte and Schensul, 1999). Eventually, twenty CIOs from a three state northeastern region were selected once the purposeful sampling method determined that no new data categories would be discovered or additional useful information would be collected from additional participants. Following the 'case-selection' procedure, participants were grouped into *sets* for two major reasons. The first reason was to conduct an iterative analysis of the collected data from a small set of in-depth interviews and observations at one time to discover key research data categories rather than to analyze participant data one individual at a time. The second reason was to specifically select study participants who represented a diverse group of industries, enterprise size, CIO education and experience, and enterprise IT organization characteristics (LeCompte and Schensul, 1999).

Participants in this study represented different industries (pharmaceutical, finance, utilities, manufacturing, insurance, and education), both public and private entities, and varying enterprise sizes (Fortune 500 enterprises, small and medium enterprises (SME), and very small business enterprises). This study targeted different industries and enterprises from the very largest Fortune 500 to the very smallest under the assumption that most industries and different sized enterprises experience the common problem of managing uncertainty and unexpected change. This variety of participant characteristics was also used to comparatively determine if the problems of uncertainty remained constant or differed across industries or enterprise size and if CIOs managed uncertainty as well as expected change differently across industries and enterprise sizes. And, finally, the potential application of enterprise IT organizational flexibility as a technique to improve managing uncertainty and unexpected change across industries and enterprise sizes was also explored.

CIO LEADERSHIP STUDY FINDINGS

In a qualitative exploratory study, the goal of the discussion of research findings is to answer both broad and general questions about the study's problem domain as well as more specific and detailed questions unique to the problem domain (Wolcott, 1990). In this short conference paper and presentation, we've limited the discussion of study findings to those impacts and recommendations relating to CIO leadership.

CIO leadership is critical to preparing the enterprise IT organization for uncertainty and unexpected change

- *Flexible CIOs overcome barriers to change* - CIOs mentioned that barriers are often caused by both employees and executive strategies that make it difficult for them to make broad, organizational changes as required by dynamic business conditions. This is supported by Goldman, Nagel, and Preiss (1995) in their list of forces that threaten companies in rapidly changing global marketplaces. Some of these barriers caused by employees and executive strategies

include shrinking product lifetimes, convergence of physical products and services, simultaneous inter-company cooperation and competition, and pressures to internalize prevailing social values.

- *Flexible CIOs create a work atmosphere of continuous change* - Generally, enterprise IT personnel fear change as do most employees. CIOs mentioned that if enterprise IT personnel were less fearful of change, the IT personnel would be better able to deal with changes affecting their functions. As Ross (2003) describes, through their leadership, CIOs can enable organizational changes to develop an atmosphere of continuous change and show employees the bigger picture of how uncertainty and unexpected change affect IT as a whole.
- *Flexible CIOs balance control with innovation* - Volberda's (1998) research on organizational flexibility confirmed that the leaders of *flexible* enterprises still maintain the management functions of coordination, control, and focus, while, at the same time, focusing on innovation, creativity, and speed. Poole and Van de Ven (1989) also identified how important it is that leaders of organizations mix both stability and change as a way of life, since organizations are continuously changing. This need for leadership was also supported by Benamati and Lederer (2001) in their studies on coping mechanisms for changing IT.
- *Flexible CIOs set a flexibility example* - CIOs, themselves, also need to be comfortable with the impacts of change in order to set examples for the entire organization. Just as the executives of the firm must develop strategies to exploit opportunities and adopt coping mechanisms to minimize threats, Knoll and Jarvenpaa (1994) described how CIOs must do the same. Benamati and Lederer (2001) explained that enterprise IT executives would be more successful if they used coping mechanisms such as *maintain your own training staff or document differences between new and previous IT*.
- *Flexile are as reactive as their customers* - Several CIOs pointed out that one way to position the enterprise IT organization to better handle uncertainty is to develop a strategic objective to be as *reactive* as the enterprise IT customers are. This viewpoint is supported by Dietrich and Shipley (1999) who pointed out that the enterprise IT environment is *anything but stable* due to the nature of the IT business and the impact of IT on the business. Dietrich and Shipley recommended that enterprise IT organizations should develop a new model of business that is both more responsive and also more proactive.
- *Flexile CIOs anticipate changing customer needs* - Another way for CIOs to be more comfortable with change is to determine how well change is managed. A key measure of success when managing unexpected change and becoming more flexible is the enterprise IT organization's ability to focus on the needs of its internal and external customers by continuously changing and creating enterprise IT value (Davern and Kauffman, 2000; Brown and Eisenhardt, 1997). When trying to determine measures, one CIO stated that he felt his enterprise IT organization currently had a *flexibility quotient* [his term] of about a ten, but, in reality, he felt it should be closer to an eighty [on a scale from one to a hundred].
- *Flexile CIOs manage unexpected change differently than expected change* - A key role of CIOs is to manage issues, especially caused by unexpected changes. One CIO explained that, in his experience, uncertainty follows the 80/20 rule. Eighty percent of change is expected, while twenty percent is a surprise or completely unexpected. Galbraith (1973) supported this concept of some unexpected change happening when he defined uncertainty as the gap between how much information is required to do the work and how much information is known.

Recommendations for how the CIO can better prepare the enterprise IT organization for uncertainty and unexpected change

The following recommendations from the study findings summarize key activities for CIOs to better prepare the enterprise IT organization to deal with uncertainty and unexpected change:

- *Create an environment that encourages and tolerates risk-taking to encourage employees not to fear change.* Do not over-react when taking a risk doesn't work out as expected. This supports what Falkowski and Krebs (2004) found that the most successful organizations had personnel who were adaptive and good at dealing with change, while those less successful organizations had people who were not adaptive and could not deal with change.

- *Be willing to stop technology projects mid-way when necessary to mitigate the risk and to demonstrate that potential negatives can be turned into positives.* Just because eighty percent or even ninety percent of a project is completed, if ten percent is a problem, which will negatively affect the enterprise, then the entire project is a problem.
- *Manage across the hierarchy of the enterprise.* An enterprise's CEO and senior executives will be more supportive of needs of the enterprise IT organization if they have a better understanding of the impact of unexpected changes on the on-going IT support to the enterprise. According to Volberda (1998), flexible resources and strategic thinking are not enough for flexibility and adaptation. This also requires people to sense and make sense of their environment. All of the organizational stakeholders must understand the *strategic schemas* or *frames of reference* that are necessary to interpret and understand the organization and its environment. Hamel and Prahalad (1989) referred to this as *strategic intent*, where the most successful enterprises develop foresight and can imagine new services and products and even businesses that do not exist as yet.
- *Develop a management framework to use as a guide when dealing with uncertainty and unexpected change as well as expected change.* Unexpected change can be managed by decomposing or breaking the problems into smaller parts. A CIO can then analyze the impact of the smaller parts on the individual components of the enterprise IT organization before making key decisions.

CONCLUSION

The goal of this ethnographic inquiry was to better understand the complex organizational, social, and human issues dealing with the impact of uncertainty from the perspective of CIOs who lead enterprise IT organizations in dynamic business environments. We explored many key factors associated with managing uncertainty. The findings identified and reinforced some logical and expected management practices, but we also found some unexpected conclusions. For example, CIO leadership is critical to success when managing uncertainty, however, proactive CIOs *understand the external business environment* as well as they understand the internal business environment, which means CIOs need to become as knowledgeable about their industry as they are about information technology. Also, proactive CIOs consider and manage *uncertainty* as if it were an *opportunity*. CIOs using dedicated IT *account reps* for key customer groups were more agile than other IT organizations because they were prepared for unexpected changes and they always looked for how IT could solve business problems.

Some of the other conclusions are that, even though we all know that change is constant, the impact of change varies greatly. *External business change*, expected or unexpected, almost always results in more uncertainty than internal business changes. Also, both unexpected changes and planned or expected changes usually lead to additional changes not expected. CIOs agreed that managing unexpected change is very different than managing expected change. In this short conference paper and presentation, we've only been able to discuss a few of the findings from this research. More research needs to be done to further explore these findings and develop specific recommendations. However, hopefully some of these findings can be used by CIOs to better manage uncertainty in today's dynamic business environments.

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