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RISK-BASED SENSEMAKING USING MULTI-LEVEL MATRIX

ENTERPRISE PROCESS MODELS

A Thesis in

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by

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ABSTRACT

Risk is an important but under-investigated issue for organizations in the increasingly turbulent and complex environment. In this unpredictable world, managing risk and seeking reliability are critical for one organization staying ahead of other competitors. Organizational risk becomes more subjective and unquantifiable in postmodernity. In risk-based sensemaking, external representations provide people knowledge that is not available in their internal representations and then interact with their internal representations. This interaction stimulates sensemakers to become more effective in sensemaking.

Enterprise architecture is an emerging area that seeks to organize and visualize the structural features and relationships associated with processes, people, technology, and information in an organization. In this study, an enterprise process model—a subset of the enterprise architecture—is used to clarify the complexity of internal architecture and enterprise-wide operations within an organization. This study proposes that showing the process model provides a visual aid and therefore enabled sensemakers to become sensitive to operations, which leads to their mindfulness. In addition, the enterprise process model reduced the complexity of the entire enterprise and pre-structured the information around sensemakers, which would affect the sense human can make. Therefore, the explicitation of the enterprise process model would play a relevant role in the risk-based sensemaking.

This study tries to bridge two different areas—the enterprise process model area and risk-based sensemaking area. A multiple case study was conducted with employees in a newly established college in a public research university. For each participant, an interview and a survey were performed to elicit a list of perceived risks. The set of risks was analyzed using the grounded theory. Result showed the support for the argument that there was a relationship

between enterprise process modeling and risk-based sensemaking. However, the strength of the relationship was affected by the amount of new information captured from the process model.

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Chapter 1   **Introduction**

The trend in the enterprise architecture has opened up new possibilities for managing organizations using the enterprise-wide approach. This enterprise-wide approach provides a new lens on risk-based sensemaking, one of the most pivotal activities that can impact an organization to avoid loss and achieve objectives.

I am interested in risk in that it is a key component of modern organizations (Smallman and Smith 2003), and the importance of risk management cannot be emphasized more in organizations. Risk, in general, refers to the possibility of loss or injury. In the context of organizations, it is a possible event or circumstance that can negatively affect the performance of the organization. These negative effects can be the difficulties to attain business objectives, or the inability of organizations to execute business processes effectively (Bell, Marrs et al. 1997).

This study implements the idea of an enterprise-wide approach to anticipate and manage business risks. Risks are omnipresent (Ekberg 2007), and particularly embedded in and intervene with business processes. They are considered the product of specific social, organizational and managerial processes (Power, Scheytt et al. 2009). This study explores the contribution of the enterprise-wide process model to risk-based sensemaking. Traditional risk management, proved by a survey of financial services institutions worldwide, tend to focus on financial, predictable, and quantifiable concerns, and pay comparatively little attention to less visible, unquantifiable, but equally threatening   risks (Coopers 2002; Coopers 2004). To manage risk on an enterprise-wide basis, organizations must be concerned about economic and political factors, reputational risks, along with risks related to ethics and data integrity (Coopers 2002). This study investigates perceived risks, which exists in consciousness of individuals and can be either real or imaginary. Traditional risk management consists of identifying risks, assessing their likelihood, and trying to

mitigate them, while these risks are real-existing. Perceived risks, however, are hardly statistical calculated or monitored since they are invisible or even not existing (Ekberg 2007). They can in turn influence personal, political, social and financial decisions because they are believed as real and are responded to even if they actually do not exist (Ekberg 2007).

Knechel (2002) explains an effective process for identifying potential events that may bring in risk, and claims that this process contains describing internal operations of an organization and identifying how internal operations help the organization achieve its business objectives. This study employs this idea to provide a holistic view for an organization, explore how the organization creates value through processes, and examine how this holistic view can help with identifying risk, no matter it is real or imaginary.

An emerging area providing the holistic view is the Enterprise Architecture (EA), which seeks to organize and visualize the structural features and also relationships associated with processes, people, technology and information in an organization. One important branch of the EA study is the enterprise process model, which captures the way that organizations work internally. The process-centrism in the BPTrends EA Pyramid Model shows the trend that more and more efforts are put on processes. Compared to the EA, the enterprise process model does not get aspects like people or technology involved. However, the only emphasis—process— is capable of capturing the essence of the entire enterprise because it is the process that adds values to an organization's operation. As defined by Johansson, a process is "a set of linked activities that take an input and transform it to create an output. Ideally, the transformation that occurs in the process should add value to the input and create an output that is more useful and effective to the recipient either upstream or downstream" (Johansson and Pendlebury 1993). Being a major objective of an organization, value adding is implemented through processes. Processes are where structure, people, technology, strategy, and other components in an organization come together.

Therefore, the enterprise process model simplifies the complexity brought about by modeling every facet of an organization, but meanwhile grasps the essence.

Either the risk management or the EA has become well-known and important research directions. However, the potential of bridging these two areas together has not been fully developed or realized. Given that the enterprise process model makes work and information flows visible, this study tries to prove that there is a relationship between the explicitation and people's risk perceptions.

1.1 A Bridge between Enterprise Process Models and Risk-based Sensemaking

Recent years witness a change of the nature of risks from an objective or fixed definition of social or technological features of society to a way of conceiving of society and decisions (Gephart Jr, Van Maanen et al. 2009). Gephart *et al.* also argue that risks are commonly linked to decision making in organizational contexts. Environments, ethics, and actions are also elements that linked to risk.

As a rigorous description of both the organizational structure and relationships associated with processes, environments, people, information, and technology, the EA provides a big picture of the enterprise. It is believed to be helpful in improving business performance and bettering the execution of core missions. This is because the key to effective performance lies in maintaining situational awareness and the big picture of current operations (Weick and Sutcliffe 2001). Besides, the EA process bridges the gap that otherwise exists between business strategy and technology implementation (Bittler and Kreizmann 2005). Bittler *et al.* suggested that process-oriented organizations tend to highly perform, compared to other organizations. A process-oriented organization is an organization that inherently views its operations and organizing logic as being built around a process architecture (Clark and Cameron 2008). Processes are receiving

more and more attention as the essence of organizations. However, currently they are mainly a concern of engineering alone (Magalhaes, Sousa et al. 2007). The enterprise process model is seldom used as a tool to facilitate risk-based sensemaking.

This study tries to bridge the enterprise process model and risk-based sensemaking, which are two different areas. One premise is that the members of the modeled organization will get to know more about the work environment by viewing the enterprise process model. The information gained from the enterprise process model can reflect on risk-based sensemaking.

1.2 Research Questions

The main research question of this study was formulated as follows:

" Is there a relationship between enterprise process modeling and risk-oriented sensemaking?"

If there is a relationship, a follow-up research question was then established to explore the nature of this relationship:

"How does the enterprise process model, if any, influence enterprise risk perception?"

1.3 Research Overview

This study investigates risk perceptions in a newly established college within a public research university. Administrators, faculty members, and staff members were recruited to participate in the study. All of them have worked for the college for no less than two years. The general description of this college will be given in the case study section.

This study consists of an interview and a follow-up survey. The interview is designed to elicit a list of risks from participants. In the interview, participants were first asked to come up

with a set of risks without any external references. When no more risks can be come up with, they were shown an enterprise process model, which illustrates high-level operations of their organization. We expect that the assistant of external representations can stimulate participants to identify more risks. The interview data were analyzed using grounded theory. Considering that these risks are enumerative items and cognitive maps illustrate the interrelationships of cognitive concepts, I did not develop any cognitive maps to test participants' sensemaking. The identified risks by the same participant were compared between the cases with and without the assistant of the enterprise process model. The presence of identified risks was compared for each participant. The interview also asked questions regarding participants' impressions about the enterprise process model. These comments can be viewed as overall evaluation of the study and also as guidelines of future studies. As to the survey, the data collected were used to provide complimented information to the analysis of the interview data.

1.4 Thesis Outline

In Chapter 2, related literatures are reviewed. Chapter 3 describes the methodology that we used to conduct the study in a newly established college of a public research university. Chapter 4 discusses the finding based on the case study, as well as the limitation of this case study. The last chapter concludes this thesis.

Chapter 2   Literature Review

This chapter reviews four areas that contribute to the theoretical foundation of this study: risk management, organizational sensemaking, organizational representations, and educational organizations. Sections 2.1 to section 2.4 review each of the above areas in detail.

2.1 Risk Management

Risk management is an ongoing iterative process to identify potential events that may bring in loss, assess these events, minimize their impact, and monitor their evolution. Literatures summarize this process as an iterative flow from risk assessment to risk mitigation, and then to evaluation and assessment (Stoneburner, Goguen et al. 2002). The risk assessment process encompasses risk identification and risk evaluation of both possibilities and impacts. Risk mitigation refers to prioritizing, implementing, and maintaining the appropriate risk-reducing measures (Stoneburner, Goguen et al. 2002).

Organizations manage risks by nature, which is one of the most important activities in organizations. Recent years have witnessed increasing concern about risk management, especially in organization or enterprise context. One representative definition of this particular risk management, enterprise risk management (ERM), is as follows from the Committee of Sponsoring Organizations of the Treadway Commission (COSO): "Enterprise risk management is a process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives. (Coso 2004)"

An IBM report studied various ERM definitions and specified three critical requirements that effective ERM must satisfy: ERM must be integrated—spanning all lines of business, comprehensive—covering all types of risk, and strategic—aligned with the overall business strategy (Petit and Latimore 2005). These characteristics of ERM necessitate that we inspect the definition of risk to ensure risk can be covered appropriately and comprehensively.

The concept of risk varies widely in different areas. As Michael Power argues in "the Risk Management of Everything", risk is termed as many different events and things, even

though these concepts are contested and incongruent (Power 2004). Even each discipline has its own definition of risk. Althaus argues that risk reflects the preoccupations, strengths, and weaknesses of each disciplines and therefore is endued with different meanings in different disciplines (Althaus 2005). In consistent with what Power said (Power 2004), in these disciplines, risk can be "both calculable and indeterminate, objective and subjective, visible and invisible, knowable and unknowable, predictable and unpredictable, individual and collective" (Althaus 2005) and tends to be confusing when mentioned. This study will only focus on the risk research in organizational context.

Table 1: Contrasting Modernist and Postmodernist Assumptions Regarding Organizational Risk (Miller 2009)

Dimensions of Contrast	Modernist Assumptions	Postmodernist Assumptions
Unit of Analysis	The individual is the primary unit of analysis for understanding organizational risk.	Risk is a social and multilevel phenomenon.
Risk Preferences	Risk preferences are given and left unexplained.	Risk preferences, perceptions, and responses are learned.
Risk Quantification	Risk is objectively quantifiable.	Risk is subjective and unquantifiable.
Nature of the Environment	The environment is given and probabilistic.	The environment is a complex, socially constructed system.
Ethics	Ethical considerations are omitted.	Ethical considerations are integral to risk assessment and management.
Risk Responses	Decisions are the key way that organizations respond to risk.	Actions, not just decisions, respond to risk.

Organizational risk is associated with varied meanings as the era shifts. Table 1 lists the summarized differences between organizational risk in modernity and in the era of postmodernity

by Miller (Miller 2009). One noteworthy point is that in modernity organizational risk relies on probability theory and is viewed as a measurable and calculable matter. Risk is calculated as the product of its probability and magnitude. The pervasiveness of this quantification even informs the risk management up to date and many risk management projects control risk quantitatively, by monitoring key performance indicators, for example. The coming of postmodernity shifts risk towards subjectively perceived and unquantifiable (Gephart Jr, Van Maanen et al. 2009; Miller 2009). One reason of this change is that risk has become more global, less readily identifiable, more problematic, less easily managed, and more anxiety-provoking (Beck 1992). Another is that risk is not only associated with unitary decision makers as it is modernistly, but also with everyone in organizations. Risk has become a social and multilevel phenomenon (Miller 2009). Experts may have data to identify and measure risk quantitatively while ordinary employees, who are considered laypersons in risk management, will only judge subjectively. Cognitive science, in response to this, tests how well these objective risks are identified by lay people and the distinction between experts and lay people brought about by bias. Therefore, it is suggested that subjective perceptions of risk should be a supplement to objective calculations of risk (Lash, 2000). Risk perception is what this study will investigate. Which is different from the risk research from cognitive science perspective is that even experts are not aware of all potential risks correctly.

Risk perception has been a focus of research for several decades. It measures people's emotional response to potential accidents, and the response is due to people's subjective experience of "being-at-risk" or living an "at-risk" identiy, heuristics and bias, mass media, and so on (Sjoberg 2000; Ekberg 2007). The perceived risk varies across people because of their sociodemographic diversities, which include gender, ethnicity, age, education, occupation and prior experience (Ekberg 2007). People's perception regarding risk is achieved through

sensemaking of properties of the environment, processes, and structures of organizations (Weick 1995).

Another change regarding organizational risk listed in the above table is that it is a social and multi-level phenomenon rather than individual's responsibility. Many risks are produced by the complexity of organizations and the interactions inside of organizations and even between organizations and external environment. Many uncertainties are resulted from organizational, cultural, and human factors. Risk research from social-cultural perspective emphasizes the social and cultural contexts where risks are understood, interpreted, and mitigated (Gephart Jr, Van Maanen et al. 2009). Gephart *et al.* underlined the imperative of re-embedding risk studies in organizations. The sources of organizational risk can be both the interdependence among individuals' actions and regulation and institutionalization of norms, as argued by Miller (Miller 2009). Therefore, there is a need to frame risk as a multilevel phenomenon to incorporate individual effect as well as organizational and societal effects (Miller 2009). All the above prompt us to examine the structures and processes of organizations.

In response to the trend of risk management in organizations, the COSO developed a framework to describe key principles and concepts in risk management, a common language, and clear direction and guidance (Coso 2004). This framework provided eight interrelated components that compose enterprise risk management: (1) internal environment (2) objective setting (3) event identification (4) risk assessment (5) risk response (6) control activities (7) information and communication (8) monitoring. What we are interested in is event identification, which is defined as identifying internal and external events affecting achievement of an entity's objectives and distinguishing between risks and opportunities. Internal environment modeling and objective setting are required before we conduct event identification. Internal environment refers to the tone of an organization, the environment in which the organization operates, and the risk culture such as the basis for how risk is viewed and addressed by an entity's people (Coso 2004).

Appropriate objective setting should be consistent with the strategic objectives of the organization and done before enterprise risk management can identify potential events affecting achievement (Coso 2004).

Similar with what COSO framework, the first step to conduct risk evaluation, as Knechel (2002) suggests, is a broad view of the organization's environment. The purpose of this step is to identify and prioritize risks to the organization. This is also referred to as strategic analysis because any events that prevent organizations from achieving their strategic objectives are viewed as risks. The second step is to identify and understand the components of the organization's external environment that have potential to become the primary sources of risk, and the internal operations of the organization that can also cause risk.

External environment is beyond the scope of this study. The reason is that "the internal operations of the organization are defined based on the necessary interactions with the external environment as influenced by the organization's strategy; the design of specific processes will be greatly influenced by the external environment; external risks are often manifested as specific internal risks" (Knechel 2002).

2.2 Sensemaking

The concept of sensemaking (Weick 1995) provides a theoretical foundation based on which we can interpret the processes of risk identification. Through the process of sensemaking, organizations deal with unpredictability and respond effectively to the environment (Seiling and Hinrichs 2005). In organizational life, the construction of risk perception also takes place within the processes of sensemaking (McKenna 2001).

One representative definition of sensemaking is "the reciprocal interaction of information seeking, meaning ascription, and action" (Thomas, Clark et al. 1993). Information seeking is the

gathering of properties of the environment, internal processes, and structures of organizations. However, the properties of the environment perhaps are ambiguous, confusing, and full of uncertainty. Sometimes the signs of risk are embedded in rich context and rather weak. People must actively identify and interpret these signs. By meaning ascription, people enlarge these small signs, interpret confusing events, and search for contexts within which small details fit together. Meaning ascription is rarely self-evident, which requires us in the information-seeking step to organize useful information into structures to facilitate rational interpretation and further data seeking. Then the decision to take an action against risk—which is termed as "enactment"— informs another round of sensemaking.

Another definition of sensemaking by Russell et al. (1993) is the process of searching for a representation and encoding data in that representation to answer task-specific questions. This definition seems quite different from the previous one. I would suggest that these two definitions complement to each other and give us a richer understanding of the process of sensemaking. During information seeking step in sensemaking, sensemakers gather information and store it in their mental models, which are internal representation in their cognition. The representation captures the context and data needed for sensemaking, which can be properties of environment and organizations. To conduct meaning ascription, their mental models should capture the structural knowledge created during the sensemaking process. In sensemaking, sensemakers' doubt emerges in their internal representation of the context.

Although abundant literatures talk about risk management as well as sensemaking, few of them talk about the processes of sensemaking that identifying risk in details. Macrae (2007) argues that current risk analysis methods tend to ignore these initial processes of risk identification, and focus on the measurement and prioritization of risks. However, the initial processes of risk identification are quite critical because they determine what issues will receive further investigation. In risk identification, people tend to focus on previous risks, notice and

bracket emerging or hidden signs in surrounding environment, apply their limited knowledge to deal with these signs. New types of risk are possibly neglected. Their risk perception will be affected by their understanding of surrounding environment, which is a result of the following factors: How people interpret information and make sense of risk depends on factors including personality, age, gender, background, experience, and knowledge. Communication is another influencing component through which people collectively get new findings and make sense (Weick, Sutcliffe et al. 2005).

Weick provided seven properties for the sensemaking process, which can be used to guide the sensemaking process, and explain the result of sensemaking and actions-to-take after sensemaking. We will use these properties to explain the processes of sensemaking regarding risk.

Table 2: Seven Properties of Sensemaking (Weick 1995)

| Seven Properties of Sensemaking	
Grounded in Identity Construction	Sensemaking begins with a sensemaker. The result of sensemaking is on the basis of the perspective of that sensemaker.
Retrospective	The most distinguishing characteristic of sensemaking. Explanations of the present are made possibly from meaningful lived experience.
Enactive of Sensible Environments	The sensemaker often produces part of the environment they face.
Social	Sensemaking is affected by the intertwining of the cognitive and the social.
Ongoing	Sensemaking never starts and never stops.
Focused on and by Extracted Cues	Focus on certain cues that are chosen out of the many potential cues. The extracted cues are taken as equivalent to the entire datum from which it comes.
Driven by Plausibility Rather Than Accuracy	Sensemakers just need to find plausibility. Accuracy is nice, but not necessary.

When sensemakers try to do risk-based sensemaking, these properties reflect on their risk perception. "Grounded in identity construction" is in consistent with what we talked about above—risk perception is restricted by many factors of sensemakers. For example, if sensemakers are managers, "they tend to focus on a narrow band of organizational risks, with a particular emphasis on a range of competitive risks and on those risks which arise from the processes of management" (Smallman and Smith 2003). Gender and age also are variables that will affect individual's risk identification and risk judgment (Fischer, Morgan et al. 1991). Retrospective implies that sensemakers' past experience will also influence their sensemaking, of which follow-up actions are possible to produce part of the environment they will face in the near future. Each person's perception of risk is different, and they may arrive at different assessments of the same risk situation, which reflects their personal experiences and circumstances, local contextual issues and local knowledge, and communication with others (Thompson 1980; Bazerman and Moore 1994; Healy 2006).

Although individuals have different risk perception, their means of identifying risk are the same: focusing on extracted cues and enlarging small moments of doubt. Macrae (2007) treats doubts as fleeting signs of organizational ignorance—a space where the organization are poorly understood and latent risks may be hidden. Doubt appears when sensemakers examine their internal representations of the context. When faced with challenging or problematic incidents in terms of currently accepted beliefs and models of operational safety, people may have doubt emerging (Macrae 2007). It is doubt that drives people towards sensemaking, which is stated by Weick as "driven by plausibility rather than accuracy."

To be aware of small cues and interpret them, people should be both mindful and constructively accountable (Seiling and Hinrichs 2005). Mindfulness is essential to making sense in organizations as a precondition of sensemaking and defined as "a rich awareness of discriminatory detail." The rich awareness comes from the fact that mindfulness deals with the

interrelations among the processes of perception and cognition (Weick and Sutcliffe 2001; Weick and Sutcliffe 2006). It is more about inquiry and interpretation grounded in capabilities for action, and less about decision making (Weick and Sutcliffe 2001). It is mindfulness that enables sensemakers to pay attention to what is happening, and therefore possible to identify risk.

Weick *et al.* suggest five processes as the premises to a state of mindfulness (Weick and Sutcliffe 2001). They argue that all organizations can follow these processes to become more mindful. As shown in the following figure, these processes are tied together to create mindfulness that can enhance the organization's ability to discover and manage unexpected events, even the "little things" that otherwise can culminate in a crisis situation. I am interested in "sensitive to operations", which means that when the focus is what is going on at the operational level, small events get big attention and seldom blossom into crisis situations (Weick and Sutcliffe 2001). Organization members are more possible to frequently review their performance, operations, and environmental conditions; they are more possible to detect latent risks, develop intuition and flexible options; they are more possible to deepen their personal knowledge of their organization, and then improvise to cope with the unclear and changing environment (Eisenhardt and Tabrizi 1995; Brown and Eisenhardt 1997). However, sensemakers tend to have obscure understanding about their environment and the overall working processes in their organization.
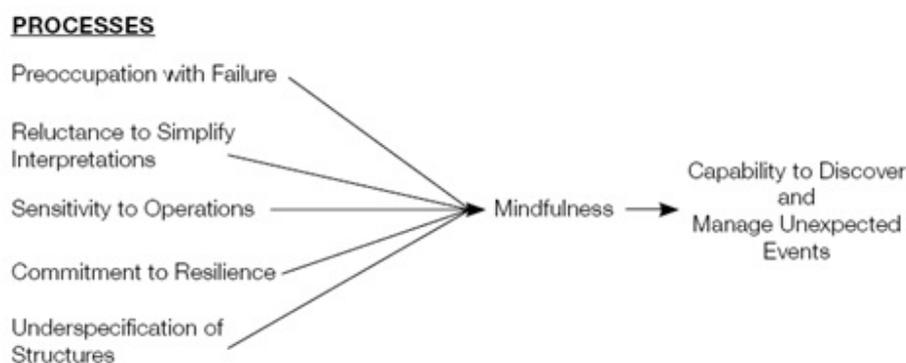
Figure 1: A mindful infrastructure for the capability to discover and manage unexpected events (Adopted from Weick, Sutcliffe et al. 1999)

Although it needs endeavors to affect organization members' mental models and get them sensitive towards operations, their possible lack of knowledge about their organization is likely decreased with an external representation of operations, which in turn enables them to be clearer about what is going on and going wrong within their organization. We propose that finding appropriate representations for business processes is a critical aspect of risk-based sensemaking, based on the sensemaking theory of Russell et al. (1993).

Representations include both internal representations and external representations, which are already mentioned in previous paragraphs. Internal representations—mental models—exist in cognition and play a major role in sensemaking. Usually when sensemakers are asked about their perceived risk, they exclusively focus on their internal representations. They retrieve the information in their internal representations through cognitive processes, which can sometimes be triggered by the cues in external representations (Zhang 1997). External representations, in contrast with internal representations, are usually graphical representations and stored physically. Information in external representations provides people knowledge that is not available in their internal representation (Chambers and Reisberg 1985). The new picked-up knowledge thus can interact with existing internal representations, and be analyzed and processed by sensemakers' perceptual systems. The interaction includes external representations working as memory aids for sensemakers to extend working memory, working as knowledge inputs, and more importantly, working as stimuli to the internal mind (Zhang 1997). Russell et al. (1993) suggest that the use of external representations support the cognitive demands and is helpful in reducing sensemaking cost, especially when the information required is too voluminous and the internal representations are inadequate, incomplete, or ill-formed. Baker, Jones et al. also argue that visual representations of data can serve the sensemaking goal (Baker, Jones et al. 2009).

In risk-based sensemaking, sensemakers need adequate useful information about the context. However, the true environment is characterized by heavy information load, high

complexity, and frequent turbulence (Weick 1995). The ever-increasing information creates a burden for sensemakers to managing information and form complete internal representations. People tend to omit some information that is perhaps helpful in sensemaking. The increase of complexity in the system that to be interpreted also brings about perceived uncertainty of sensemakers. So does the instability or randomness of environment. These properties necessitate the use of external representations, which can pre-structure what people will notice and affects the sense they can then make (Weick 1995).

2.3 Representations of Organizations

A better understanding of an organization is a primary foundation for the risk-based sensemaking of this organization. If we are to make sense of the risks of an organization, it is necessary to have a clear picture of this organization—its internal structure, external environment, how it works, and so on. For different tasks, different representations have different efficiencies and can cause different cognitive behaviors (Zhang 1997). In this section, I will compare different representations of organizations—techniques that describe the picture and help us recognize and represent an organization. These representations are only more or less appropriate models for sensemaking; there is no "right" or "correct" model of anything at all (Beer 1966).

Among these visual representations, traditional approaches are usually from the structure perspective. A typical example is the organizational chart, which uses unit silos in a hierarchy. Traditional approaches, however, usually are not capable of helping with making sense. For example, unit silos restrain the organizational chart's ability to facilitate advanced sensemaking in that how the organization works is unavailable. Being a management platform, a holistic representation—enterprise architecture—is emerging and extremely popular. It is viewed as a

promising tool to identify opportunities to improve organizations. This paper will focus on the enterprise architecture and its subset—the business process model.

2.3.1. Enterprise Architecture

Enterprise architecture (EA), in a nutshell, is a holistic picture of an organization, depicting how information and technology and other assets will support the business operations and provide benefit for the business. Lankhorst et al. defined it as "a coherent whole of principles, methods, and models that are used in the design and realization of an enterprise's organizational structure, business processes, information systems, and infrastructure" (Lankhorst 2009). In short, the EA is supposed to outline the holistic view of an enterprise.

The EA provides an umbrella for managing the complexity of enterprises, which is a desired feature of external representations. The EA is supposed to play a critical role in enabling better designs for enterprises, analyzing their performance, reducing the ever-increasing costs, and responding to environmental changes quickly. Therefore, the EA has become a major focus in the competitive business landscape and a number of large companies are coming to use the EA to improve their business performance. Governments are another group that adopts EAs as their operation tools and many state governments have already built their EA frameworks, exemplified by the Michigan Enterprise Architecture Plan (TheMichiganGovernment).

A lot of EA frameworks were developed to provide references for these initiatives, ranging from the very beginning Zachman Framework (Zachman 1999) to the NIST EA model (Council 1999), to company-developed frameworks like the BPTrend EA Pyramid Model (Harmon 2004). Common bricks that comprise these frameworks—strategies, policies, infrastructures, knowledge, processes, technologies, and people—generally can be divided into four tiers, suggested by the IFEAD (Institute for Enterprise Architecture Developments) (2009):

- Business planning (e.g., goals, visions, strategies, and governance principles);

- Business operations (e.g., business terms, organization structures, processes, and data);

- Automation (e.g., information systems and databases);

- Technological infrastructures (e.g., computers, operating systems, and networks).

Admittedly, if implemented well, the EA is a powerful tool to reduce IT costs, ease risk management, create shared business platforms, increase managerial satisfaction, and make strategic business impacts (Ross and Weill 2005). However, it is possible that, for a small organization or a simple application, a complete EA implementation will bring in tombs of information. The cost of creating and maintaining an EA perhaps is greater than the value it can bring in. As an example, sticking to the full Zachman EA Framework (Zachman 1999) means an investigation of over thirty individual perspectives.

For sensemaking purpose, it is not necessary to try a full EA. The process subset of an EA is usually capable of helping people fulfill most tasks. The reason is that the EA is a process discipline, although it also describes other aspects of an organization (Bittler and Kreizmann 2005). In nature, all organizations are in fact only a series of processes, "interlocking routines, and habituated action patterns that bring the same people together around the same activities in the same time and places" (Weick 1995). More importantly, these action patterns are connected through a value chain, which ensures the processes are a coherent whole without silos.

2.3.2.   Enterprise Process Model

As a subset of the EA, the enterprise process model provides a big picture of internal operations in organizations. The big picture enables a common understanding and analysis of the business processes within the organization. We can analyze the organization through investigating its process model. Capturing how an organization internally works, the enterprise

process model draws an organizational context, pre-structures the information around sensemakers, and facilitates human understanding to make sense of aspects of an organization.

The bricks that compose of an enterprise process model is processes, which are "the specific ordered, measured sets of work activities across time and space, with a beginning, an end, and clearly identified inputs and outputs designed for a particular customer or market (Davenport 1993)." Rummler and Brache point out that most business processes are cross-functional, spanning the "white space" between boxes on the organization chart (1995). Processes can be categorized functionally into two groups: "core" processes (also called primary processes) and "supportive" processes. Core processes deliver products or services that are going to be consumed by external customers. Supportive processes can be in charge of financial or treasury management, information management, human resource management, property management, and regulatory management (Bell, Marrs et al. 1997). The products or services that supportive processes deliver are invisible to external customers but essential to the organization. Both types of processes can be further decomposed into subprocesses and sub-subprocesses until unitary activities.

There are different granularities in process visualization, ranging from the low-level representation (fine granularity) to high-level representation (coarse granularity). Granularity refers to the detail level of the process model and affects the kind of guidance, explanation and trace that can be provided (Rolland 1998). Although fine granularity is preferred because of more detailed capability, the nature of granularity needed is dependent on the situation at hand (Rolland 1998). Organization managers tend to prefer rather large-grained process model because they need to get an overview for decision-making. In contrast, workers at the lower levels of an organization hierarchy will prefer a fine-grained process model because of the details that the model can deliver. Examples of fine-grained process representations include a number of well-developed notations, like flow charts, petri-nets, BPEL, and BPMN. All of them are engineering-oriented process representations, and aim to accurately represent the process logic so as to

automate and re-design business processes. A number of enterprise process models are developed in governments and companies with high quality and elaborate details. These fine-grained process models, however, are not suitable for sensemaking. Facing with them, sensemakers are easy to get lost in the forest of detailed process logics and therefore unable to get an overall picture of the organization, let alone making sense. To serve as a sensemaking tool, the enterprise process model should have different emphases on model quality, compared to the models taken as process automation analysis tools in companies, for example.

Our process model is expected to create a common frame of reference rather than an exact model of which correctness we can even mathematically verify. An important part of sensemaking is to understand events, situation, or information. As a tool for communication and sensemaking, it is enough to represent the model on a high level as long as people can understand and put their own meaning into it, considering that the model is intended neither to automate processes, nor to re-engineer some specific processes. The appropriate process model should be of the right size and form of "map", with the right cognitive complexity to help individuals find their way without missing essential information (Henneberg, Naud et al.). The model should meanwhile avoid over-complicating the mental representation of the environment with unnecessary detail (Henneberg, Naud et al.). Hence, to create a common vision across an organization, the syntactic correctness and semantic completeness is usually only of minor importance (Krogstie, Dalberg et al. 2004).

Risk-based sensemaking aims to get a high-level perception about risk from the context. Past study suggests that high-level perception involves taking a more global view of information and is most relevant to the central problems of cognition (Chalmers, French et al. 1992). Therefore, coarse granularity of process models is more helpful in risk-based sensemaking than fine granularity. But how many levels are needed in a process model for risk-based sensemaking? Without doubt that the first level, the most abstract diagram, is definitely needed and gives

sensemakers a rapid and general idea about the organization. To what extent we need to further model processes depends on different type of sensemaking. If the purpose of sensemaking is to explain general problems in an organization, two or three levels are enough to describe an operational picture of the organization. If the process model is used to conduct more advanced sensemaking, fine granularity is preferred but the granularity must be controlled.

In addition to granularity, another problem with process modeling is the structural type. When we try to model an organization into cohesion of processes, we are facing with many different ways to organize these processes. Sarah et al. classify sensemaking representations into six types: spatial, argumentational, faceted, hierarchical, sequential, and networked (Faisal, Attfield et al. 2009). Spatial, argumentational, faceted, and sequential alignments are not suitable for process modeling. Many studies are in favor of hierarchy. "A practical guide to federal enterprise architecture" points out that "it is critically important that EA development be approached in a top-down, incremental manner, consistent with the hierarchical architectural views that are the building blocks of proven EA frameworks. (Council 2001)" "To tear down the functional stovepipes" is a major part of building an enterprise architecture (Ashmore, Henson et al. 2004). Although these statements supporting hierarchy are talking about the EA, these modeling principles also apply to the subset of the EA—the process model, which provides us a simpler view of the organization

A few studies, however, debate that probably it is not appropriate to decompose an enterprise into a hierarchical structure. Allee argues that our understanding of the organizational dynamics is limited given a framework that only "breaks a living enterprise down into functions or individual processes, and then pastes it all back together as an engineered whole system" (2002). According to Allee's argument, a networked model is ideal for better guidance and analysis, which allows for many-to-many relationships and is definitely what we aspire for. Therefore, the complex social structure can be supported by the networked model, which captures

interdependent exchange relationships. Similar arguments include that Henneberg and Mouzas et al. describe network pictures as sensemaking devices (2006).

One reason that this study uses the hierarchical model is that networked models involve more complex modeling and more advanced analysis techniques. For the purpose of aiding sensemaking, the hierarchical model is more easily processed by sensemakers and then stimulates their internal mind. Another reason is that the investigated organization is a loosely coupled system, which will be discussed in the next section. As a loosely coupled system, there are limited interdependencies between the organization's components. It is not necessary to model the organization as a network. Hierarchical modeling is capable of capturing the operational context of the organization.

To build an enterprise-wide high-level process model, one important guideline is to organize processes by the value chain (Ashmore, Henson et al. 2004). It is necessary that we relate the hierarchy to the value chain and business strategies that all employees and managers in the enterprise can refer to for future planning and communication purposes. All processes should accord with these strategies, otherwise they perhaps fall into a dangerous sub-optimization zone—the stovepipe. Building the enterprise process model starts with getting an organization's business mission, acquiring the business strategy, and arranging the processes along the value chain, ends with decomposing these processes down to detailed operational tasks. The process model is unfolded as a multi-level hierarchy, with the business mission sitting on the top. Drilling down through this model, processes reveal increasing-detailed activities. There are several process architecture levels sorting from top to bottom: a value chain which crosses enterprises and usually is linear or sequential; main processes which are cross-functional, start and end with the same stakeholder, require multiple skills to perform, and add value to stakeholders; sub-processes which are also cross-functional and could across many levels in a hierarchy; activities

which are performed within a function, start and end with different stakeholders; tasks which are usually performed in group or person; and steps which are performed individually or procedurally.

2.4 A Look into Educational Organizations

Recent years have witnessed that educational organizations are facing with increasing probability of risks. A high quality education, in parents' and policymakers' perception, is increasingly tied to social and economic betterment (Stringfield and Land 2002). Less than a generation ago educational institutes thrived in an environment of predictable funding and student enrollment with little overt competition among institutes (Gioia and Thomas 1996). Recent years witness the significant shifts of higher education. Gioia and Thomas argued that recent economic, demographic, and political changes have cast colleges and universities into an ambiguous arena that looks more and more like a competitive marketplace. The increasing critical economic recession further shapes educational organizations to be more business-like because of more emphasis on competition for resources. As many other business organizations, educational organizations are facing a variety of operational, strategic, and financial risks. Its operational risks arise from inadequate or failed internal processes, people and systems or from external events, whereas strategic risk is the risk of a loss arising from a poor strategic business decision according to the definition given by Basel II (Basel 2004). Financial risks are the loss associated with any form of financing, e.g., credit, interest rate, or capital.

Educational organizations often heavily rely on the external partners, such as the local high school students, government, or other research institutes. These almost fixed types of partners create resource dependence. Scholars observed that the modern academic environment has brought a disquieting trend toward declining enrollments, reduced funding, and external competition (Gioia, Thomas et al. 1994). Tight links exists between the potential student pool and

the student recruiting plan in that enrollments are no longer as stable as decades before. Operating funds are another uncertainty that may challenge educational organizations, compared to the days that they were more or less guaranteed either by governments or other traditional sources. Almost all productive research that takes place with funding in the educational arena is asserted that almost tied to the wishes of grantors, who come from either industry or government or even individual (Kalas 1987). The demand for law, policy, or order within educational organizations is another tight link between external controlling bodies (e.g., the federal government) and educational organizations (Duryea 2000). Therefore, resource dependence embeds the educational organizations in a university-industry-government system that fuels the research economy, the overall economy, and society (Kalas 1987). Each transaction in this environment should be taken into account in sensemaking, not just in the university (Atkinson and Gilleland 2006).

In addition to resource pressure, characterized by rapid and discontinuous development of technology, the high-velocity environment brings time pressure to educational organizations. Educational organizations should keep pace with technology changes, should be a pioneer as the ones that diffuse knowledge and lead technology innovation. The liability of newness asserts that during an organization's life course, young organizations are at the greatest risk of failure because of the learning of new roles, trust building among members, stable connections with clients (Stinchcombe 1965). For most educational organizations, they have quite a long history. But there are still some that are in their infant stages. They are still quite young compared to other educational organizations and are facing more challenges.

Reputation is another type of major risk for most organizations, which has been for centuries a cornerstone of the status of elite organizations but has been a new subject of concern in risk research. As a valued but highly vulnerable corporate asset, reputation more generally attracts the attention of organizations and is taken as a part of organizational risk management. In

the educational context, reputation is the quality of public perceptions as to a combination of the universities' research ability, teaching quality, educational atmosphere, and other issues. These perceptions may generate social reactions that affect universities' operational functions. Besides, universities are facing with the growth of external ranking bodies, such as the U.S. News, which evaluate and compare them with competitors, and thereby generate reputational risks.

In a nutshell, educational organizations are tightly coupled with the external environment. The educational organizations themselves, however, are loosely coupled systems with loosely coupled internal work activities and outputs (Meyer 1980).

Many scholars, for instance, Birnhaum, characterized the educational system in the United States as a complex system. Simon defined a complex system as "one made up of a large number of parts that interact in a non-simple way…. In such systems…given the properties of the parts and the laws of their interaction, it is not a trivial matter to infer the properties of the whole" (Simon 1962). Simon also argued that the complex system can be decomposed into stable subassemblies with relatively little disturbance and that these subassemblies are the crucial elements in any organization or system (Simon 1962). This provides a risk management rationale for modularizing organizations (Miller 2009).

Educational organizations are characterized by Weick and Mintzberg as loosely coupled (Weick 1976) and loosely coordinated (Mintzberg 1979). Loosely coupled organizations tend to have much fewer tight links between these subassemblies than tightly coupled organizations. Therefore, for loosely coupled organizations, changes in one component do not necessarily affect others. On the contrary, in tightly coupled organizations, small errors can swiftly spread to other components of the system through these links. Therefore, managers of organizations often pursue for loose coupling in their organizations in order to exhibit more flexibility and respond more quickly to changing requirements and conditions. Loose coupling of routine activities enables people to notice problems and then intervene before they cause harm (Tamuz and Harrison 2006).

Chapter 3   **Methods**

The purpose of this study is to develop and examine an enterprise process model with the purpose of supporting risk-based sensemaking. This dissertation aims to understand the complex process of sensemaking, and how external representations facilitate the specific type of sensemaking. This chapter describes the methodology and is organized as follows: Section 3.1 and 3.2 sketch the research design and the studied organization, respectively. Section 3.3 describes the development of the enterprise process model. Selection and characteristics of participants and their tasks are discussed in section 3.4. Data collection methods and procedures, and data analysis methods are talked about in section 3.5 and section 3.6, respectively.

3.1 Research Design

To address the research questions "Is there a relationship between enterprise process modeling and risk-oriented sensemaking?" and "How does the enterprise process model influence enterprise risk perception", this research uses multiple case study (Yin 2009) to explore and compare how a small number of participants search their mental models for risk-based sensemaking tasks without and with an enterprise process model.

The reasons employing a case study approach include that (a) the focus of the study is to answer "how" the process model will affect sensemaking; (b) the study will cover contextual conditions as well as demographic factors because they are relevant to the phenomenon under study (Yin 2009). Demographic factors such as personality, age, gender, experience, and position will influence how people analyze and interpret information (Coulter and Coulter 2003). Weick and Bougon also assert that organization members edit their own organizational experience into

patterns of personal knowledge, the representation of which forms their unique cognitive patterns (1986). If compare sensemaking across individuals, we need to control these demographic factors to abstain unbiased outcomes. The variety of these factors creates difficulty to the study design. Besides, it is these factors that shape people's risk perception. Therefore, a case study is chosen to study the individual effect that the enterprise process model brings about. To replicate findings across cases, a multiple case study is conducted to interview a number of different people, which allows us to explore differences within and between cases.

To provide a shared context for interviewees, the study first develops an enterprise process model. The process model provides a means of developing a broad understanding of the effectiveness of the design and management of the organization, and how the internal processes interrelate with each other and with outside entities.

3.2 Setting and Context

The studied organization is a relatively new-established college that approximately has a history of ten years in a public research university. The college is built to respond to the rapidly growing demands for a new generation of leaders of the Digital Age. The demands shape the college as a multidisciplinary and collaborative organization, which embodies diverse groups or fields including computer science, engineering, psychology, and business. As a newly established organization, the college does not offer as many majors as other colleges, and is of a relatively small scale. By the spring semester of 2010, the college has 48 faculty members and approximately 60 staff members. Five associate degree options are offered to students. 2309 students are enrolled in the undergraduate program and 99 students are enrolled in the graduate program. The college is gaining increasing attentions as a thriving academic body. Nowadays, the college is an emerging new group in higher education, and a leader in its field.

The reason that we choose the college as the study object is two-fold: Educational organizations are one kind of long-standing traditional organizations, which serve quite stable functions for quite stable consumers. In contrast, many of other types of organizations are facing with ever-changing environment and are subject to internal adjustments. Educational organizations are characterized by Weick and Mintzberg as loosely coupled (1976) and loosely coordinated (1979). Because of loose coupling, the modeling of educational organizations becomes relatively easy without rambling relationships.

Notwithstanding, the college is still facing with daunting fiscal and demographic trend. As a member of a public university, the college depends on both state and university appropriations for its operating, while the economy is right at its low ebb. The enrollment and tuition, as another source of fiscal revenues, are challenged by the decreasing population. Recently, the college is going through the interim of changing deans and a public recruit of the new dean. A strategic change is potential with the arriving of the new dean.

Current risk management of the studied organization is undertaken both in the college level and university level. As a part of the university, the college has a representative, who is affiliated to the university risk management team and provides the university necessary information. Team members are responsible for collecting and reporting data to the university. The data are to be analyzed using Oracle Business Intelligence Suite Enterprise Edition (OBIEE). In the college level, the organization also maintains local tables monitoring the college performance on as many aspects as possible. A dashboard project is under developing for routinely storing data relating to each potential risk and monitoring these data. The dashboard will show a red light if any monitored parameter exceeds acceptable levels. Once warned by the red light, managers can "drill down" to find the reasons, collect useful information, and make more informed decisions (Banham 2004). Performance indicators are carefully chosen in the dashboard project, of which examples are shown as follows:

- Student placements and starting salary

- Internships

- Senior exit survey

- Outreach contacts

- Scholarship and endowments

- Papers published

- Sponsored research hit rate

- Teaching quality

- Curricular assessment

- Faculty specific research

Current risk monitoring does a satisfying job in ensuring organization performance. These indicators do capture the status of the organization and then warn the organization to respond to any possible downsides. However, the monitoring is constructed under the assumption that the organization knows potential risks. There are also other types of risk: the unknown risk and the unknown-unknown risk, for example.

3.3 Develop the Enterprise Process Model

The construction of the enterprise process model adopts Knechel's approach (2002). "Value chain" is used in construction to make sure that processes achieve a cohesive state. The "value chain" approach starts from strategic analysis. The COSO framework (2004) and Knechel (2002) support that strategic analysis, providing a broad view of the organization's environment, should be the first step to conduct risk evaluation. Bell, Marrs et al. suggest that five corresponding analytical processes—strategic analysis, business modeling, core business process analysis, resource management process analysis, and information management process analysis—

comprise an ensemble of analytical procedures rooted in the strategic-systems perspective (1997). These five processes also are consistent with our approach and inform the following business modeling.

According to Knechel (2002), the second step is to identify and understand the components of the organization's external environment that have potential to become the primary sources of risk, and the internal operations of the organization that can also cause risk. Only internal operations are going to be modeled here in that they are defined based on necessary interactions with the external environment (Knechel 2002). Sticking to the value chain thinking, the strategy and goals of the studied organization are decomposed to extract main processes and supportive processes. Webpages of that organization are also resources that used to identify main processes and supportive processes. Verification of these processes and further decomposition are completed after semi-structured interviews with key stakeholders of the organization. In the semi-structured interviews, the key stakeholders first verified the correctness of the extracted processes, and then described how internal operations were conducted. According to their descriptions, each process is decomposed into a set of sequential sub-processes, which are connected by the value chain. Then these collected data are structured into a hierarchical process model.

These processes are modularly modeled in the enterprise process model. Modularity is a useful means of managing the complexity of large-scale interdependent systems (Ethiraj and Levinthal 2004). Simon states that decomposable systems reduce the need for coordination and allow for buffering different subsystems from one another (1962). Hence the modularity of decomposable systems. Since educational organizations are loosely coupled, modularity is a natural way of representations. Baldwin and Clark propose another sense of modularity, which is the mental modularity within the overall architecture of the cognitive system (2000). People tend to cognitively group strongly interacting components together and separate weakly interacting ones even these components are not grouped in that way. Chalmers, French et al. suggest that raw

data must be filtered and appropriately organized to yield a structured representation that can be used by the mind as a coherent whole (1992). Therefore, modular cognition calls for a modularity process representation. Cognitive fit theory proposes that the matching between task and information presentation type leads to superior task performance (Vessey 1991). According to Vessey, by using external representations that match mental models, sensemakers do not need to transform their mental representations. Instead, they can extract and process information from problem representations more easily and directly, and then solve the problem.

In this study, we build a modular representation of high-level processes within the studied organization. To facilitate risk-based sensemaking, the process model only crosses two levels. In consistent with the assertion that all business processes should accord with the business values and business strategies (Smith and Fingar 2003), the building of the enterprise process model starts from getting the organization missions and goals. Main processes and supportive processes are identified from organization goals and interview data. These processes are further broken into several sub-processes, where the decomposition also follows the value chain. It is possible that several sub-processes are kind of ambiguous to define the relationship between them, and therefore are not modeled in sequential order. There are six stages to build the enterprise process model for the studied organization:

- Identification of the organization mission;

- Identification of the organization objectives or goals;

- Extraction of main processes and supportive processes from the organization goals;

- Validation of these extracted processes;

- Decomposition of processes on a basis of the value chain;

- Validation of the enterprise process model.

In the first step, both the organization mission and goals can be found in the strategic plan of the studied organization. The strategic plan is available in the organization website. The mission of

the studied organization is specified as follows: "*Through our teaching, research, and service, our people will change the world with inspired solutions, based on humanized technologies, and the conversion of data to information, information to knowledge, and knowledge to wisdom.*"

The goals of the studied organization contain the following areas:

• **Educate** *information professionals who are uniquely able to use information and technology...to synthesize new knowledge and to design the innovative technology and systems necessary to solve the most pressing problems...*;

• Do **research**, **teaching**, and **outreach** *that will foster the deeper understanding and better innovation needed to solve the millennial problems that we face as a society...*;

• **Achieve excellence** *in the information sciences and technology field and beyond, and in all aspects of our mission at the nexus of people, information, and society so that we are undisputedly the best i-school at the conversion of theory into action and action into practice*;

• **Diversify** *the college so that it is well prepared to weather the storms that will face us...in student demographics in the Commonwealth of Pennsylvania, to the continuing upward cost of education....*

After identifying main processes—research, education (both educating undergrads and educating graduate students), diversification, and outreach (managing events/coordinating outreach, managing fund raising/alumni relations), information about their sub-processes is acquired through browsing the organization's website and talking with employees of the organization. Table 3, Table 4, and Table 5: Process Decomposition of Managing Diversity show the decomposition examples of main processes. The other main processes are discomposed in the same way. In addition to the main processes, supportive processes are also discomposed, which are regarding financial or treasury management, information management, human resource

management, property management, and regulatory management (Bell, Marrs et al. 1997). A whole integrated graph which was used in the interview is shown in Appendix A.

Table 3: Process Decomposition of Managing Research

Research Goal: Achieve excellence in its field and beyond.						
Manage Research						
Find Opportunity	Ensure Policy Compliance	Write Grant Proposals	Obtain Funding	Perform Research	Manage Research Facilities/ Labs	Publish Research

Table 4: Process Decomposition of Managing Undergrads

Education Goal: Educate information professionals who are uniquely able to use information and technology…to synthesize new knowledge and to design the innovative technology and systems necessary to solve the most pressing problems…					
Manage Undergrads					
Manage Curriculum	Recruit Students	Teach Students	Advise Students	Assess Progress	Place Students

Table 5: Process Decomposition of Managing Diversity

Diversification Goal: Well prepared to weather the storms that will face us…in student demographics in Pennsylvania, to the continuing upward cost of education…			
Manage Diversity			
Lead the College Diversity Committee	Develop Strategy to Enhance Diversity	Manage Organization Climate	Recruit People of Diversity

Validation of the enterprise process model is conducted in interviews with employees of the organization. While we do aspire to a model revealing precise internal operations, the data we gathered to some extent contain perceptual processes. These perceptual processes reflect the understanding of interviewees about operations of their organization. In validation, most interviewees admit that the process model captures the internal environment without mistakes. However, there are also interviewees pointing out that some sub-processes are categorized inappropriately. To support sensemaking, the process of searching for an appropriate representation is considered iterative (Russell, Stefik et al. 1993). The process model, without doubt, is a very beginning draft and far away from perfect. Revise is needed by mending its representation residuals (Russell, Stefik et al. 1993).

3.4 Participants and Tasks

Case study focuses on a small number of cases that are expected to provide insight into propositions that intend to apply to a larger population of cases (Gerring 2007). Cases chosen in a case study should be representative of the overall population. Randomization can be used to choose cases for large-sample study. However, sometimes the number of cases in case study is rather small. Case selection must be carefully conducted to ensure selected samples are representative.

In this study, eight participants are recruited from the studied organization. All of them have worked in this organization for at least two years. This provides insurance against that these participants know little about their organization. Among these eight participants, there are two administrators, two staff members, and four faculty members. Faculty have a lot of influence over the future of the college, so their perceptions are extremely important. Therefore, special emphasis is put on faculty. To represent all stakeholders in the organization, administrators and

staff are also recruited as interviewees. Although demographic factors influence the sensemaking, these effects are eliminated by comparison within case analysis.

Generally speaking, participants need to list risks in their organization. Participants are first required to come up with risks without the help of any reference; then they are shown an enterprise process model to help with their risk identification. These identified risks are not necessary to real-exist in the organization, but rather are participants' perceptions regarding risk, either real or imaginary. To test the relationship between enterprise process modeling and risk-based sensemaking, we compare two courses of sensemaking of the same participant. Therefore, the role of participants in the organization is not that crucial.

3.5 Data Collection Methods and Procedures

This study consists of an interview and a follow-up survey. The interview is designed to elicit a list of risks from participants. The data collected in the survey is expected to provide complimented information to the analysis of the interview data.

In this study, a case defined as one sensemaking session is a unit of analysis (Yin 2009). That is, a participant working on the task without the assistance of the enterprise process model, and with the assistance of the enterprise process model, are both the unit of analysis. Private and semi-structured interviews were conducted.

During the semi-structured interviews, data were collected by only taking notes. First, participants were asked to provide their position and responsibility information, which would be kept confidential. Then key performance indicators and risks were elicited by them, following by a qualitative evaluation of the enterprise process model. In detail, participants were first asked to come up with a set of risks without any external references. When no more risks can be come up with, they were shown an enterprise process model, which illustrates high-level operations of

their organization. We expect that the assistant of external representations can stimulate participants to identify more risks. In the interview, informants provided not only the risks but also some reasons leading to risks. These interview questions are listed in Appendix B. Following the interview, a survey was also conducted to ask the participants to rate the overall risk management of the college. Participants should select answers based on their cognitive out of seven levels. The survey questions are also listed in Appendix B.

Interviews were transcribed by taking notes. Transcriptions were coded against an initial coding scheme. Along with the coding of more transcriptions, the initial coding schema was updated by adding emerging themes. Each pair of cases that happen on the same participant is compared. After the individual comparison was done, a cross-case analysis was conducted to discover any common patterns in multiple cases and reach a holistic understanding of the question being studied.

In the interview, participants were asked to answer open-ended questions to come up with risks in their organization. Traditionally, risk perceptions are usually elicited using checklists. To some extent the use of checklists prompts participants identifying risks, but there is an inherent difficulty in the use of such lists (Smallman and Smith 2003). Providing a risk repository for respondents picking, the checklists tend to frame and constrain discussion around the issues rather than allow participants to articulate both depth and breadth of their perceived uncertainties (Smallman and Smith 2003).

3.6 Data Analysis Methods

This study uses grounded theory (Glaser and Strauss 1967) to look systematically at the interview notes, and identify a set of risks from interview data. Interview data were coded using constant comparative analysis (Glaser and Strauss 1967). Through observing the similarities and

differences of identified concepts that arise from data, we catalogue recurrent themes. Direct interpretation (Stake 1995) and existence comparison (Lowstedt 1993) were used to analyze interview data.

Chapter 4   **Findings**

The interview data were analyzed using grounded theory. Considering that these risks are enumerative items and cognitive maps illustrate the interrelationships of cognitive concepts, I did not develop any cognitive maps to test participants' sensemaking. The identified risks by the same participant were compared between the cases with and without the assistant of the enterprise process model. The presence of identified risks was compared for each participant. The interview also asked questions regarding participants' impressions about the enterprise process model.

4.1 Interview

4.1.1.   Phase 1: Pilot Study

The pilot study is designed to validate the bias brought in by personal experience. An administrator, a staff member, and two faculty members were interviewed to prove it. Because of their different levels of risk perception, they are representative of the overall population in their organization. As analyzed above, the interview data should suggest that variance exists between participants in the process of sensemaking. This variance is characterized by participants' positions in the organization and their expressed levels of risk awareness as well as many other factors. In this study, the administrator did not refer to any enterprise process model and provided

answers based on cognition. The staff member was shown the enterprise process model only with one level where these two faculty members were shown the model with two levels.

The risks identified by all participants in both the pilot study and the following study are listed and codified in Table 6 using the constant comparative method (Glaser and Strauss 1967). I went through the interview notes, and continually picked the identified risks, either as the exact words used by participants or as generalizations of their words. Similar risks were grouped together, and the similarity between risks was mainly determined by heuristics that these risks result from similar causes. Risks identified by other participants were continually compared to previous grouped risks, and they either joined in an existing category or created a new category themselves. All identified risks were added to the category list in such an exploratory way. The abstracted risk categories were not further aggregated into second-order categories.

After have all identified risks codified, these risks will be analyzed merely for existence although many qualitative researches employ cognitive maps to study the order and interrelationships of concepts that comprise cognitive schemas (Gioia and Manz 1985). The existence analysis will show how participants' cognitive schemas about risks shift across people and time. Participants' cognitive schemas—the frameworks by which people organize and interpret environment in sensemaking—provide the reference points by which people understand the environment (Lowstedt 1993). Their cognitive schemas also evolve along with their interpretations of environment to resolve the uncertainty inherent in the situation during the course of sensemaking. However, participants in this study were asked to identify a list of risks, which hardly had relationships between them. Cognitive maps with either proximity relationship or causality relationship or other relationships do not fit in this study. Besides, existence analysis has successfully been employed by many studies. For example, in Palmquist's classroom study, he observed the changes in the presence of concepts over the course of the semester, instead of establishing a cognitive map of all concept terms (Palmquist 1992).

Table 7 shows the comparison of participants' answers in the pilot study. The identified risks in this table are termed as the summarized codes with the serial numbers as the prefixes, which indicates both the summarized risk categories and the detailed risk descriptions and enables the retrieval of the details. For example, D10 indicates "the inconsistency of leadership roles" in the "improper leadership" category.

Table 6: Identified risks and codified risks

Informant Codes	*Summarized Codes*

1. Budget reduction resulted from gloomy state economy;
   a) Difficulty in providing competitive salaries for faculties and staff;
   b) Difficulty in providing support for traveling to conferences;
   c) Difficulty in providing resources to students
2. Difficulty in finding donors and raising funds;
3. Declining research funding;
4. In the next two years, the college will under very tough financial time;
5. Flat money get from the university
	A. Declining funding

6. Low financial efficiency; 7. Employees' misunderstanding about the usage of funding;	B. Risks in the usage of funding
8. The steam generation will convert to natural gas, which will increase the operation cost;	C. Increasing costs
9. Leader's lack of vision towards forward future; 10. The inconsistency of leadership roles; 11. The risk in defining and refining proper strategies;	D. Improper leadership
12. Not mature enough as a newly developed college; 13. Difficulty of advertizing the college; 14. Unclear responsibilities of employees because of the tension between being a college and a department;	E. Liability of newness and identity
15. Affected reputation, which can affect grants, retention of employees, etc.;	F. Reputation
16. Large number of undergrads; 17. Large number of courses taught by faculties;	G. Heavy burden of educating

Table 6 (continued): Identified risks and codified risks

18. The risk of developing unsatisfactory curriculum;

    a) Courses offered are too easy for undergrads.

    b) Courses offered are application-driven and do not focus on foundation.

19. Curriculum cannot compete with other institutes;

H. Unsatisfactory curriculum

20. Declining enrollment;
21. Number of high school students is declining;
22. Unbalance of undergrads in each grade, especially the big hole that will be created by the graduation of senior students;

I. Decline of the number of undergrads

23. Low percentage of females in undergraduate program;
24. Different gender distributions of the two majors in the college;

J. Difficulty to achieve diversity

25. Low morale and culture climate, which requires communication and motivation;
26. Unsatisfactory students' attitude;

K. Unhealthy climate

27. Did not recruit high-quality faculties and students
28. Do not have the right person at the right place;

L. Unqualified employees

29. Struggle to have cutting-edge technology that used for teaching and research and stay relevant to the real world
30. Fail to adjust to the technology development and the globalization brought about by new technology

M. Pressure from changing technology

31. Space constraints of graduate students
32. Online program has potential to be mimicked by others, where online program is partially because of the space constraints;
33. Events are conducted out of the college due to space constraints;
34. The risks about resource management, e.g., limitation of resource allocating;

N. Limited resources

Table 6 (continued): Identified risks and codified risks

35. Competition from other educational institutes, e.g., community colleges or other colleges in the same university;

    O. Pressure from competitors

36. Accidents regarding to building management (e.g., lost articles, access control)

37. Security risk of the computer system

    P. Risks in routine work

Table 7: Comparison of the answers of these four participants in the pilot study

	Participant 1 (Administrator)	Participant 2 (Staff)	Participant 3 (Faculty A)	Participant 4 (Faculty B)
Shown Model	No model	Model with one level	Model with two levels	Model with two levels
Past Risks	A1. Declining funding	A1. Declining funding	L27. Unqualified employees	A1. Declining funding
	J23. Difficulty to achieve diversity	D10. Improper leadership	D10. Improper leadership	D10. Improper leadership
	E13. Liability of newness and identity	N31. Limited resources	I20. Decline of the number of undergrads	E12. Liability of newness and identity
	K25. Unhealthy climate		H18. Unsatisfactory curriculum	
Current Risks	A1, A1a), A2. Declining funding	A1, A3. Declining funding	A2. Declining funding	A3. Declining funding
	F15. Reputation	D10. Improper leadership	D11. Improper leadership	D11. Improper leadership

	I20. Decline of the number of undergrads	N31. Limited resources	H18. Unsatisfactory curriculum	I20. Decline of the number of undergrads
	M29. Pressure from changing technology	M29. Pressure from changing technology	L27. Unqualified employees	L27. Unqualified employees
			K25. Unhealthy climate	N34. Limited resources
Emerging Risks	A4. Declining funding		H18. Unsatisfactory curriculum	N34. Limited resources
	C8. Increasing costs		L27. Unqualified employees	I20. Decline of the number of undergrads
	I21. Decline of the number of undergrads			

An interpretative approach was used to analyze participants' risk-based sensemaking, and the result was given as a narrative. If the interviewees were not affected by the aforementioned factors, the administrator have should been the one identified the least number of risks where these two faculty members have should been opposite to the administrator, and the staff in-between.

In order to get the overall risk perceptions of these four participants, answers to the survey questions of these four are listed in the following table, where a large number indicates a large extent and a small number stands for a small extent.

Table 8: Answers to survey questions.

	Participant 1 (Administrator)	Participant 2 (Staff)	Participant 3 (Faculty A)	Participant 4 (Faculty B)
To what extent is the college facing risk to its overall	5	6	6	5

performance?				
To what extent is the college willing to take strategic risks?	5	6	4	3
To what extent does risk management help improve performance of the college?	6	5	4	3
To what extent is the college prepared to face future risks to its performance?	7	4	2	4
How much time do decision makers at the college spend on risk management?	6	2	2	5
How effective do you think the college is at managing risk?	6	3	3	3

In the above table, administrators showed more confidence towards the risk management compared to faculty members and staff members, when they all showed deep concerns about risks. The positive attitude towards risk management of the administrator partially comes from more information mastered as a manager, partially comes from the inclination of self-acceptance.

For the interview question about past risks, these four participants gave similar numbers of risks: 4, 3, 4, and 3, respectively. Since risks spring from uncertainty, it is hard to tell whether the identified risks are right or wrong. The identified risks were only analyzed in terms of their categories, frequencies, and influences.

Take the question about current risks as an example. All of these four participants realized that declining funding was a big challenge to the college. However, there were some differences in the description of this risk. The administrator explained that the state budget reduction was possible to affect providing competitive salaries for faculties and staff, and that the difficulty in finding donors and raising funds is another reason of the declining funding. The

others did realize the declining of research funding, or the difficulty in raising funding, but did not relate this to the financial retaining of employees, which perhaps was another big administrative problem. Where all of these identified risks were related to financing, the strength of the funding risks identified by the administrator was larger than others. Here strength is defined as "a number that can be used in a variety of ways to indicate the presence, degree, or valence of the relationship between two concepts. Strength can be used to denote existence, i.e., whether the statement is in the text and hence in the individual's mental model. (Carley and Palmquist 1992)" This difference perhaps is due to the administrator's working experience from managing many aspects of the college, which provides much information for the sensemaking. As to the risk of improper leadership, either about the inconsistent leadership or college strategy, administrators tend to highly rate the college management, which was discussed as above using the survey data. Rather, the administrator is quite concerned about the reputation of whole college, one risk that did not identified by others. The risk "decline of the number of undergrads" and the risk "pressure from changing technology" that advanced by the administrator were identified by a faculty member and a staff member, respectively. The staff member stated and I paraphrased that "*The space constraint is perhaps a type of risks. Sometimes we are facing the difficulty to allocate offices and other resources to our graduate students.*" The curriculum development was regarded as a risk by one faculty member. These identified risks are related to participants' positions. A major part of the staff's responsibility is to allocate spaces to students and a major part of the faculty's responsibility is to develop curriculum and to teach students.

The administrator's ability of risk-based sensemaking did not show much difference from the other participants who were shown the enterprise process model. In addition, the administrator pointed out the reputational risk and the increasing costs in the following several years, which were not identified by other participants.

Based on the above analysis, sensemakers' risk perceptions are related to many factors: occupations, personality, and so on. Weick has suggested that the mechanisms of sensemaking may be tied to each level of the hierarchy in an organization and may vary (Weick 1995). The sensemaking differences between employees may be that individuals are predisposed to a position level (Weber and Manning 2001). Coyle-shapiro further explains that an employee's level in the organizational hierarchy, with its corresponding responsibility and authority, may be a critical factor affecting their sensemaking outcomes(Coyle-Shapiro 1999). Therefore, we are not going to compare the sensemaking outcomes across people. Rather, we compare individual's risk-based sensemaking outcomes with themselves. The differences between different roles also prompt us the way that chooses representative cases from the organization.

4.1.2.   Phase 2: Follow-up Study

In this follow-up study, participants consisted of an administrator, a staff member, and two faculty members. The reason is that we hope the case selection can be as representative as possible.

The interview procedures were totally the same with the ones in the pilot study, except that participants first could not refer to any external references and then referred to the enterprise process model when they answered the fifth question regarding current risks. The time to show the enterprise process model was chosen as the point that participants could not come up with more current risks. The following table lists the identified risks of each participant. Unlike the pilot study, comparison would not be conducted across participants. The analysis would focus on the changes of the presence of identified risks over the course of showing different enterprise process models. The existence of risk increment was a sign of the evolvement of participants'

sensemaking. Therefore, the comparison was between the presence of identified current risks before showing the second enterprise process model and the presence after showing the model.

Table 9: Comparison of the identified risks in the phase 2 follow-up study

	Participant 5 (Administrator)	Participant 6 (Staff)	Participant 7 (Faculty C)	Participant 8 (Faculty D)
Past Risks	A1, A5. Declining funding	P36. Risks in routine work	A1, A1 b), A1 c), A4. Declining funding	G16, G17. Heavy burden of educating
	I20, I22. Decline of the number of undergrads		O35. Pressure from competitors	
			K26. Unhealthy climate	
Current Risks (Without Enterprise Process Model)	A1, A3, A5. Declining funding	L28. Unqualified employees	A1, A1 b), A1 c), A4. Declining funding	K25. Unhealthy climate
	I20, I22. Decline of the number of undergrads	N33. Limited resources	O35. Pressure from competitors	B6. Risks in the usage of funding
	M29. Pressure from changing technology		M29. Pressure from changing technology	
	N32. Limited resources		E13. Liability of newness and identity	
	O35. Pressure from competitors		D9. Improper leadership	
Current Risks (With Enterprise Process		B7. Risks in the usage of funding	J24. Difficulty to achieve diversity	L28. Unqualified employees
		N34. Limited resources	K25. Unhealthy climate	A1 a) Declining funding

Model)		P37. Risks in routine work		H18 a), H18 b). Unsatisfactory curriculum
Emerging Risks			M30. Pressure from changing technology	
			D9. Improper leadership	

These four participants showed different levels of risk perception increment to us. The first participant, the administrator, is an employee who is in charge of the risk monitoring and financing management and quite familiar with the college situation. Despite the abundant information about risk management in the organization, the administrator did not show any risk increment.

The staff member, after being shown the enterprise process model with two levels, said and I paraphrased that "*Employees are concerned about but sometimes misjudge the usage of funding. The money sometimes is limited about the usage and cannot be used on wherever it is needed*"; "*The resources are limited in our college. For example, the graduate program was moved to the first floor in that there was no sufficient space on the floor where most graduate students are staying*"; "*The computer systems are subject to security problems like identity theft given that everyone is using computer to work.*" These additional-identified risks by the staff member were all operational risks and related to daily work of the college. On the basis of the above discussion, the type of identified risks was restricted by the staff member's personal experience, organizational knowledge, and so on. Despite this limitation, the change did show enhancement of risk-based sensemaking of the participant.

As to the two faculty members, both of them came up two risks or so after they referred to the enterprise process model, which also indicated enhancement of risk perception. However, these two faculty members showed a big variance towards the risks. Generally speaking, faculty C mentioned more risks than faculty D. At first, C identified five risks and provided detailed reasons that result in these risks. After C saw the two-level enterprise process model, C gave two additional risks to the original five. Faculty D was much more confident about the college performance and mainly concerned about developing good curriculum. D, unlike other participants who showed deep concerns about declining funding, suggested that there was little financial risk but financial efficiency should be improved. However, D also provided us a list of risks that are brought about by the enterprise process model. D said and I paraphrased that "*Some new employees were not familiar with the right workflow of their daily work. We should build a good process model as the work guidance. We also should provide good faculty support. In addition, now the provided courses are tend to follow the popularity of technology. We should teach students solid foundational knowledge like induction and deduction, and teach them how to learn on their own. Technology changes all the time. It makes no sense to chase after them.*" Although D's argument was quite different from other participants, these comments did indicate enhancement of risk-based sensemaking. This enhancement is in line with other participants.

In summary, the above cases showed a positive relationship in terms of the number of identified risks between enterprise process models and risk perception. The staff and faculty proved this through realizing more risks and showing enhanced risk perception. Although the administrator did not identify new risk after referring to the enterprise process model, he did agree that the model was helpful in providing information about the internal environment.

4.2 Discussion

Without the enterprise process model, when sensemakers were asked about their perceived risk, they exclusively focused on their internal representations. They retrieved the information in their internal representations through cognitive processes. Because cognitive processes were suggested that sometimes can be triggered by the cues in external representations (Zhang 1997), the enterprise process model was selected as an external representation. Information in the enterprise process model provides people knowledge that is not available in their internal representations (Chambers and Reisberg 1985), and is also a structural representation of their mental models. The new picked-up knowledge from the enterprise process model can interact with existing internal representations, and be analyzed and processed by sensemakers' perceptual systems.

Baker *et al.* listed four conditions when visual representations will best facilitate sensemaking (Baker, Jones et al. 2009):

- Support the four basic human visual perceptual approaches of association, differentiation, ordered perception, and quantitative perception;

- Have strong Gestalt properties;

- Be consistent with the viewer's stored knowledge;

- Support analogical reasoning.

Sensemakers may feel helpful when the visual representation can meet any one of these four conditions. Because of the complexity of an organization, it is hard for sensemakers to have full and solid knowledge about the context. Enterprise process model provides a way to organize their cognitive maps. Sensemakers showed different levels of perception enhancement, which was determined by the amount of new knowledge in the enterprise process model. In another word, the strength of the relationship between the enterprise process model and sensemaking was

affected by sensemakers' stored knowledge and the amount of information captured in process models.

Although some participants were not shown the enterprise process model when they were identifying risks, all of them were shown the model and asked about their impressions about the model at the end of the interview. Among these eight participants, three admitted that the model was helpful; three participants listed some conditions under which the model was especially helpful—when the model was shown to those who were not familiar with the organization or those who were not aware of risks, or when identified high-level risks; the other two participants suggested that the model was "potential to be helpful" or "some examples are helpful."

Although most participants agreed on the sensemaking benefits brought about by the enterprise process model, some of them showed some concerns about the model. The first concern was that sticking to an enterprise process model meant that the sensemakers tended to only focus on the risks that were tied to the modeled processes. Other high-level risks were possible to be neglected, for example, reputational risks and the risks that crossed the model. The risks that crossed the model would be neglected because the modularity design would cause the connection loss between different areas. The second concern of the enterprise process model was that it should show more details, say, a third level. A related concern was that the model did not capture all processes of the organization since it was quite easy to overlook some covert or unimportant processes. Since this research was designed to investigate high-level risk perception, the model only captured high-level operations. The third was that the organization was subject to changes whereas the process model only captured the "as-is" situation. Some scholars suggested that EA was a cultural thing and needed to be implemented in the context and culture of an enterprise, which implied that the process model should be updated with the changing context.

In addition to limitation of the developed enterprise process model, another limitation of this study is the small number of participants. I look forward to overcoming these limitations in future studies.

Chapter 5   **Conclusion**

This study bridges between two different areas: the enterprise process model and the risk-based sensemaking. In recent years, the enterprise process model has become increasingly prevalent in either academia or industry. It is prized for clarifying the complexity of internal architecture and enterprise-wide operations within an organization. Risk management is a long-standing important studying area in both academia and industry. The increasingly turbulent and complex environment requires that organizations should conduct risk management not only on the operational level as traditional risk management, but also on abstract levels. Managing risks and seeking reliability are critical for one organization's staying ahead of other competitors.

We hope that the enterprise process model can help people with risk management by providing a big picture of an organization's internal operations. The visibility of the big picture enabled sensemakers to become sensitive to operations, gain additional knowledge about the organization, and get stimuli for sensemaking.

The collected data from the interview showed support for the argument that there is a relationship between enterprise process modeling and risk-based sensemaking, although the strength of the relationship was affected by the amount of new information captured in process models. Here the influence of amount of new information is proposed but not solidly proved. This need to be investigated in future study. Future studies should also focus on developing more advanced enterprise process models, which capture more accurate processes and relationships

between processes. While this study empirically verified the validity of the proposed model using limited cases, future studies would be conducted with more participants.

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Appendix A. Enterprise Process Model used in the Interview
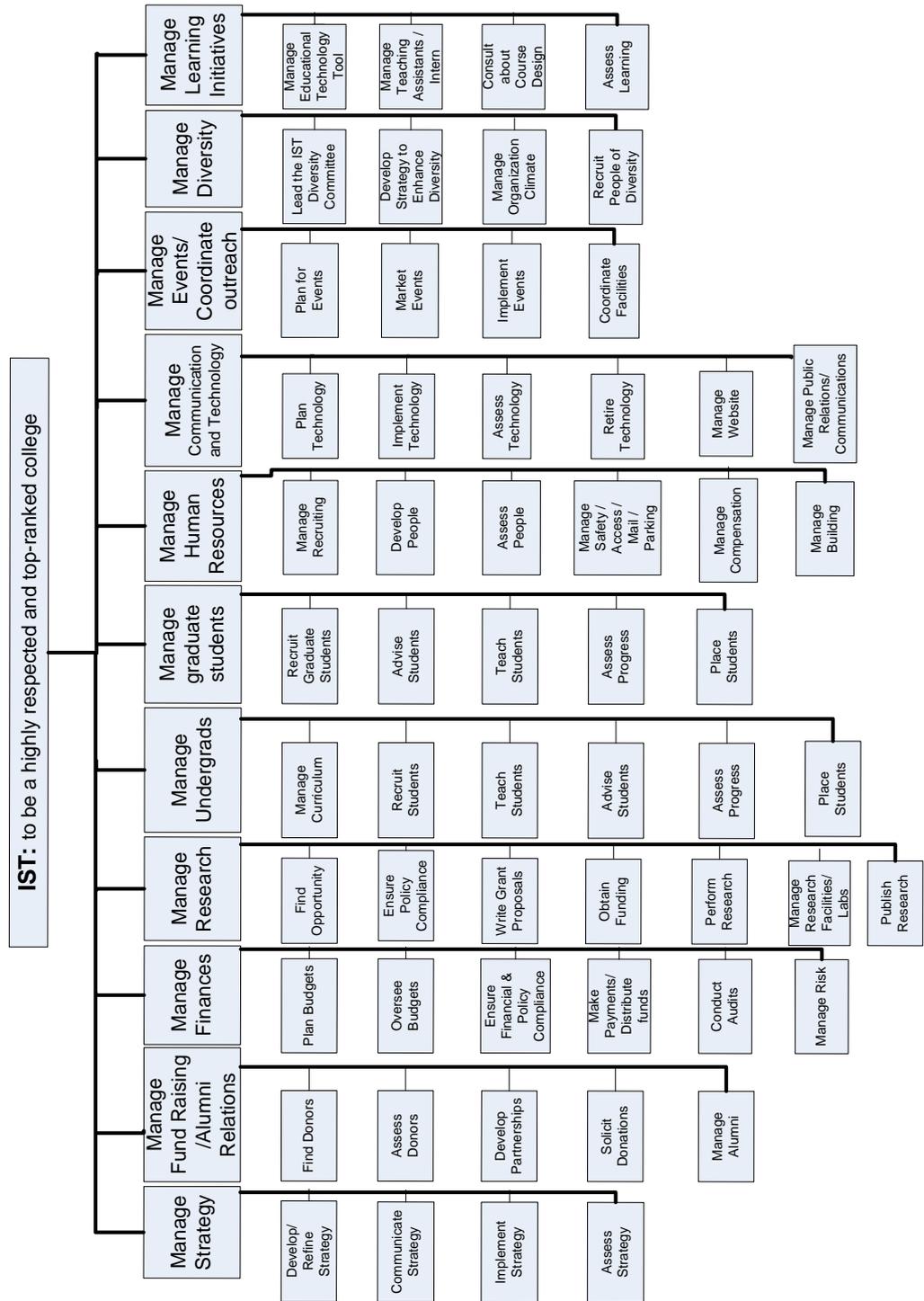
Appendix B. Interview and Survey Questions

Interview Questions:

1. What is your title?

2. What are your roles and responsibilities in the College?

3. What, do you think, are the key performance indicators of this college?

4. Over the last three years, what challenges or factors have affected the overall performance of the college?

5. Please identify the top 5-10 current risks to ISTs performance. (*Participants who are not in the pilot study were first shown the enterprise process model with one level, then the enterprise process model with two levels to facilitate and compare sensemaking.*)

6. What additional risks do you see emerging in the next 5-10 years that may affect the performance of the college?

7. Is the Enterprise Process Model at all helpful to you in identifying risk?

8. If so, how?

9. If any, in what ways did the Enterprise Process Model hinder your ability to identify risk?

10. How can this visualization technique be improved to help you identify risk?

Survey Questions:

1. To what extent is the college facing risk to its overall performance?

   To a Small Extent   To a Great Extent

   1   2   3   4   5   6   7

2. To what extent is the college willing to take strategic risks?

   To a Small Extent   To a Great Extent

   1   2   3   4   5   6   7

3. To what extent does risk management help improve performance of the college?

   To a Small Extent   To a Great Extent

   1   2   3   4   5   6   7

4. To what extent is the college prepared to face future risks to its performance?

   To a Small Extent   To a Great Extent

   1   2   3   4   5   6   7

5. How much time do decision makers at the college spend on risk management?

   No Expenditure   Huge Amount

   1   2   3   4   5   6   7

6. How effective do you think the college is at managing risk?

   Not At All   Extremely Effective

   1   2   3   4   5   6   7