ABSTRACT

Risks still give grief to information system project managers. Many believe that it would be advantageous to tackle risks earlier in the project life cycle to reduce the risk of failure with proactive approaches rather than reactive or contingent approaches. Ideally, this would track back to the roots of the risks. Using a framework of the socio-technical model, we conduct a case study to track risks in an EIS back to mismatches among the dimensions of the socio-technical model—structure, actors, technology, and tasks. Guided by the depth of task-technology task theory and the principles of consonance, we present expectations and early results regarding the risks that derive form mismatches among the various dimensions.

Keywords: Executive information systems, project risk, project management, socio-technical theory

INTRODUCTION

Executive information systems (EIS) are flexible tools that provide broad and deep information such as news, regulations, and competitive analysis for executive decisions (Poon & Wagner, 2001). Organizations often receive significant benefits from the EISs; however, EIS implementations are high-risk projects (Sherer & Alter, 2004). A great deal of past research focused on risks associated with the development and deployment of all information systems, including EIS, yet the attainment of success is still below desired levels. Often, researchers and practitioner both blame the lack of success on the presence of risk not properly managed (Bannerman, 2008). However, our understanding of risk is still limited. It is not enough to understand the presence and consequences of risk that focuses most studies, we also must understand the root causes of risk to intervene earlier in the prevention of risks in order to best achieve success.

Prior studies have generated risk lists to help developers identify and control risks (Jiang and Klein, 2000). Others have worked to categorize risks in a fashion that allows more of an analytical approach to designing risk management procedures for a particular project (Jiang, et al., 2002). Within these approaches, prior studies identified organizational, actors, tasks, and technical risk factors such as user involvement, executive sponsor’s support, appropriate and flexible hardware and software, adequate resources and well-defined requirements (Wixom and Watson, 2001; Watson et al., 2004). This is a direct result of, or in parallel to, properties of a
socio-technical model. EIS project managers must equally consider the social, cultural, organizational, and technical factors (Young & Jordan, 2008). Although these studies have provided useful insights on key risks found in EIS projects, the origins of risk is not generally considered. In particular, risk studies tend to ignore the complex relationships defined by the socio-technical model resulting in a shallow description of risks rather than the deeper examination of root causes due to secondary effects of the systems and a lack of considering the relationships among the four aspects of the socio-technical model (Bostrom & Heinen, 1977; Lyytinen, et al., 1998).

One key may be in the level considered by prior studies. Often, the system or project level is the focus of study. A higher perspective must be considered that is pointed to by a number of research streams including socio-technical models (STM), consonance, and Task-Technology Fit (TTF) theory (Bostrom & Heinen, 1977; Klein and Jiang, 2001; Goodhue and Thompson, 1995). In brief, the socio-technical model indicates that systems will often ignore effects on the people and structure of an organization when dealing with tasks and technology. Consonance argues that perceptual differences between multiple stakeholders lead to conditions resulting in failure. More narrowly, TTF suggests that a root risk to success is the match of the capability of the technology to the demand of the tasks in work environment. Each argue for an alignment – an alignment of the technical to the social, an alignment of stakeholder understanding, and alignment of technology to best accomplish a given task. In an EIS, the tasks are unique for a system requiring care in the alignment of the technology. User needs are narrowly focused, but must be fully understood by developers to deliver an effective system product. The technology dimension must not hide changes required to the decision making structure of the executives. These properties drove our decision to consider the EIS as an appropriate form to study, having many risks and properties that generate risks, while providing a manageable research boundary.

We focus on both the social-technical model and task-technology fit model, to explore risks in an EIS development and deployment project. Our goal is to back up the consideration of risks to an earlier point in the project by considering the origins of the risks and allow for earlier mitigation. Our concern is more on how risks emerge rather than what risks can be identified. In this process, we have identified a major EIS implementation to serve as our case, targeted key informants within the organization, and begun interviews. A few early results are reported.

**BACKGROUND**

Risk is defined in many ways. A simple definition is any condition that will create errors in the output of a project, or can lead to failure of a project. More complex understanding considers risk as being a potential variance from expectations, such as a large cost overrun or delayed delivery of the system. Regardless, all agree that risks must be recognized and managed to achieve success in an IS project (Bannerman, 2008; Boehm, et al., 1991). Project managers must assess risks in order to design controls that detect and respond to a risk event, mitigate the impact, or lessen the probability (Tesch, et al. 2007). However, the identification of risks is not a straightforward task (Chua, 2009). It is crucial that project managers gain an understanding of how risks can be identified and how they can change over the course of a development. Simple lists common to the literature, in textbooks, and trade books do not provide sufficient malleability or specificity to be of value for a breadth of settings and times (Jiang and Klein, 2000). Analysis approaches allow for design of controls for broad categories (Jiang, et al., 2002). Lyytinen et al. (1998) categorize risks based upon the socio-technical model include the
various people involved, the tasks required, the technology employed, and the managerial structure and processes in place. However, lists and categories may allow for planning steps to control risks, but are not sufficient to prepare for an early intervention.

One view that will enable tackling risks earlier, may be that an IS development project is an orchestration of the social ecology of an organization (Hanseth & Lytinen, 2010). As a result, risks should be considered consequences of failure to consider all associated aspects. The socio-technical model views the system development process as the interaction and alignment of four components—structure, actor, task and technology (Bostrom & Heinen, 1977). An information system can maximize its performance only if the social and technical subsystems (i.e., actor, structure, task and technology) work in harmony, while the reverse creates variance and potential errors - risk. Figure 1 shows the potential interplay of the dimensions. One relationship, between the tasks and the technology, has been examined in greater detail under task-technology fit models, and the results of fit failure well established (Goodhue & Thompson, 1995). The fit is achieved in a design process aimed at the joint optimization of the task needs and technology characteristics. Failure to fit task and technology can create variances and errors - risk.

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**Social environment**

- **Actors**

**Technical environment**

- **Tasks**

**Structure**

- **Technology**

*Fig. 1: Socio-Technical view of risks*

**Socio-Technical Theory**

The socio-technical model (STM) developed by Leavitt (1964) proposed that tasks, actors, technology, and the organizational structure in which they function as four interdependent variables, visualized as the four components of a diamond. Bostrom & Heinen (1977) proposed that system development process is composed of two subsystems: the social subsystem and the technical subsystem. This social-technical theory assumed that the outputs of the information system are the interaction of actors with tools. The social subsystem focused on the attributes of actors (e.g., skills, experience, and attitudes), the relationships among actors, reward systems, and authority structures. On the other hand, the technical subsystem focused on the processes, tasks, and technology needed to transform system inputs to system outputs. The fit is achieved by a design process aiming at the joint optimization of the subsystems; any organizational system maximizes performance only if the interdependency of the subsystem has on the other, and
planning must aim at the achievement of superior results by ensuring that all the subsystems are working in harmony (Luna-Reyes et al., 2005). Therefore, the risk management of the system development life cycle deals with not only the technical perspective but also the social perspective.

Lyytinen et al. (1998) interpreted software risks as falling into these same four categories. The model component Actors present any group or individual, who can affect or is affected by the achievement of an activity’s purpose (Leavitt, 1964). For example, actors in the software development include customers, project managers, developers, and users. The Task component describes an activity’s relations. For software development, a task covers the results, products, approaches, and goals of the software project (Persson et al., 2009). Structure includes authority relations, coordination mechanisms, degree of centralization, job design, or similar structural variables. Systems of communication, systems of authority, and systems of work flow could be such variables. The Technology component encompasses the way work is performed or the methods and equipment that are used. Zhou et al. (2008) have shown that unproven or unfamiliar technologies may cause disappointment and lead to under performance or conflicts with unrealistic expectations of technology. In these cases, risks are examined within each category.

**Task-Technology Fit**

Goodhue and Thompson (1995) proposed Task-technology fit (TTF) to explain performance impacts. Further, TTF provides a theoretical basis to guide the user and organization assessing their information systems or services. There are three importance components of the TTF model: technology, task and task-technology fit. In the TTF model, technologies are viewed as tools (hardware, software, and data) to provide services and to assist users in their tasks. Tasks are the actions carried out by individuals. The assumption of the TTF model is that information systems add value to some tasks and there is a significant relationship between performance impacts and a correspondence between task and technology. In another word, the TTF model focuses on the impacts of a specific system and it views technology as a means to complete goal-oriented tasks. Therefore, TTF model serves to link two dimensions of the socio-technical model more tightly than prior research. The TTF model’s recognition of matching can be seen in the complexity of an EIS. As task uncertainty increases, so does the variety, complexity, and ambiguity of executive information. If the technology cannot match the tasks of the executive, the system will not be a success. Consequently, when developing an EIS, project managers should seek to maximize the fit between technology features and the tasks, otherwise the product of the project is at risk.

From a more general perspective, consideration must be made in the relationship between the social side of the STM will impact the social side (Bostrom & Heinen, 1977). Consideration must be made to align these dimensions as well. Within the social side, should the technology alter the structure (bring about change), then the actors are no longer matched to the structure. To bridge the gap in the other direction, a lack of able users will not allow a successful IS product, again resulting in the failure of the project. Work on consonance shows that the perceptions of multiple stakeholders must be in agreement about the technology, or else the project will be less successful (Klein and Jiang, 2001). Thus, we would expect to find evidence in an IS project that is not aligned along every dimension to have some challenges in meeting expectations or varying form requirements – risks. Should these be surfaced, they would allow
earlier identification of risks, which can then be managed at earlier stages in the project, hopefully resulting in greater success (Jiang, et al., 2006).

### METHODOLOGY

Case methods employed by this study faithfully follow standard practices (Yin, 2009). We focus on the implementation of a major EIS project. Cases were chosen from different stakeholders of the EIS project in order to consider the entire STM. The specific case is the EIS project from the “Program of the Reform of the Taxation Information System” with total funding over 3 billion NT dollars. This EIS project shows the marked features of an EIS, because massive data comes from multiple departments, the analytic tools are complex, the reports are various, and the executives depend on the EIS to manage and control their organization. The subjects chosen for our studying are from the NTA (National Tax Administration), FDC (Financial Data Center) and CHT (Chunghwa Telecom), because they are key stakeholders in the EIS project. From these, executives, project managers, and IS professionals were interviewed. An overview of the participants to date is in Table 1.

<table>
<thead>
<tr>
<th>Case</th>
<th>Organization</th>
<th>Roles</th>
<th>Gender</th>
<th>Job Experience (Years)</th>
<th>Age</th>
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Table 1. Demographics and Responsibilities of Interviewees to Date
Interviews were conducted by a team of five or six researchers following a predefined framework. Follow up interviews continue. At each interview, one researcher briefly explained to the participants the nature and purpose of the study while the other researchers assumed responsibility for recording the responses and ensuring all questions were asked and answered. Questions varied based on the subject. Questions fell into five parts with several questions each. The parts and sample questions include:

Part 1: Organizational Strength, Weakness, Opportunity and Threat
1. What are the advantages (e.g. strength and opportunity) delivered to your organization by EIS implementation? If any, please explain how they occurred?
2. How does the EIS make impact on your organization in the future? Please give us some examples.

Part 2: Identify the stakeholders
1. Who are the stakeholders of the EIS project? Do they have enough power, resources, and time to dedicate to the EIS project?
2. Please define the roles and responsibilities in the EIS project. Who fills them?

Part 3: Individual strategic issue and action plan identification
1. What are the strategic issues in your organization to be resolved by the EIS project?
2. What are the possible barriers to implement these action plans?

Part 4: Relationships among categories and resulting issues
1. Have any important tasks been overlooked? Does the EIS respond to this problem?
2. Will the flow of communication be altered? Are there any job changes expected?

Content analysis of responses collected to date utilized both qualitative and quantitative operations. Content analysis requires exposing differences in content themes, coding answers to open-ended questions in the interviews, identifying the intended meanings of the participants, revealing the focus of the participants’ responses, and describing trends in content (Neuendorf, 2002). Content analysis can reflect team interaction patterns, reveal the focus of individual, team, institutional, or societal attention, and disclose the relationship between intent and content (Strauss & Corbin, 1998). The comments of project participants are rich in description of EIS project context and states (Newhagen & Rafaeli, 1996) and provide useful data to reveal the risk issues. The process of content analysis followed the steps recommended by Neuendorf (2002). A coding scheme was defined based on the four components of the STM. The coding categories of the software development risk were (1) task, (2) structure, (3) actor, and (4) technology. Several rounds of training were conducted until the reproducibility reliability of the results from two coders exceeded 90 percent (Strauss & Corbin, 1998). For the classification to have semantic validity, it is necessary for coding units such as words that are classified together to possess similar connotations (Weber, 1990). In this study, the coders had experience participating in system development, and were familiar with the risk management process. Semantic validity was achieved when these coders examined the list of words placed in the same category and agreed that these words had similar meanings or connotations. Reproducibility refers to the extent to which content classification produces the same results when the same text is coded by more than one coder. In this study, comparison of these two researchers’ coding results also reveals that the reproducibility between the two coders was 90.2 percent, indicating an
acceptable level of reliability (Neuendorf, 2002). The categories of the risks encountered fall clearly in the dimensions of the SCM. However, at this point the researchers do not feel sufficient evidence exists to fully validate the risks derived form the relationships among the dimensions of the STM. Further interviews are required to provide further depth and trace forward form the matching to recognized risks. However, some evidence did surface.

**PRELIMINARY RESULTS**

Preliminary support for the relationships is in the current data. The relationships suggested by applying TTF logic to each relationship in the STM and associated support are shown in the following statements.

**Task-Technology fit**

“The report format we generated did not fulfill the requirements of all departmental directors. Without the EIS forms we currently share, we were unable to integrate all information after we exported our own reports.”

“In an ideal situation, EIS would help our colleagues save time, and we could gather and integrate all information beforehand. We were not able to offer raw data to the supervisors of each office. One unit integrated and gathered all information before it was presented to the directors.”

**Technology-Structure fit**

“We were concerned the EIS might become a significant problem in the future because everyone would input their data into our system and the EIS would have to handle all of it. I believed that each department should handle the reports specific to itself, and that the directors did not need to be informed about every detail.”

“The access to the EIS system was designed based on hierarchical authority, but directors were busy, and they often had difficulty locating the reports they required when numerous reports were already in the system. Secretaries could assist with this matter, but this change would render control by authority access meaningless.”

**Technology-Actor fit**

“Numerous types of reports existed; consequently, users were required to change their user behaviors to adapt to the system. Furthermore, the installation of the system involved hardware we purchased. The hardware was Windows based and the server was graded.”

“When we hired new people, we chose those who were familiar with [a commercial EIS] and who had connections in that field.”

**Task-Structure fit**
“Why did they assign us, rather than supporters of EIS, to examine it? We were supposed to proceed with examinations without asking questions, and we were to learn from and discuss with departments that made requests…. In the end, everyone might have to propose something. If I did not propose something at that time, I might have to in the future.”

“Regarding cross-referencing, numerous struggles among departments occurred, and we compared the performance for each department in other districts. For example, we were both the heads of a certain department; as a result, if we made comparisons and references within our own management scope, everything was fine. However, if comparisons were made across departments, it was difficult to determine if the heads of the two departments would agree to the comparison. In the end, decisions continued to vary between departments.”

Task-Actor fit

“The organizational policy required employees to rotate between departments every five years, …, as a result, I took over on behalf of other people. We all hoped for certain things. For example, I was relocated, but I hoped that I could be sent back some day. Job rotation was never voluntarily; we had to constantly adjust ourselves to new tasks.”

Actor-Structure fit

“I did not think that we would be able to allocate a significant amount of developmental resources for this project; although we could handle tasks during the early stage of the project, the tasks became increasingly challenging later on. Therefore, we outsourced a large part of the project, and supplier management became essential. For example, I was a PM, but I actually monitored suppliers. This was also the reason [outsourced company name] allocated only one employee for the project.”

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