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The Antecedents of IS Software Development Team Flexibility - Research in Progress

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ABSTRACT

Information Systems Development Project (ISDP) team flexibility is essential for managing technological and business changes (Lee and Xia 2005). Although software development flexibility has been explored in IS and Software Engineering literature, limited attention has been given to how the ISDP team flexibility affects IS project performance. Drawing from the manufacturing flexibility literature and capability development perspective, this paper proposes that ISDP team flexibility can enhance a team's problem solving competency - which has positive impact on project performance. A survey method is underway to collect empirical evidence for this model. Implications for both research and practice are discussed.

Keywords

Project management, systems development, teams, flexibility, capability, problem-solving.

INTRODUCTION

Today's business world is changing at an unprecedented rate. The turbulence, globalization and innovation of the economy present a hypercompetitive business challenge. Innovative technology is invented continuously and vendors upgrade their IT products frequently. Organizations must adopt and integrate new technology with existing business practice and IT infrastructure. As business conditions and contexts change rapidly, the information systems development project (ISDP) team must deal with the volatility of business needs and user requirements.

A recent survey in 2006 by the Business Performance Management institute (BPM Forum Report 2006) found that the number one thing business wants from IT today is quick, flexible and responsive application delivery. It is equally clear that IT is not fast enough. The same survey found that only 11.2 percent of respondents could keep up with business demand to change processes. Worse, some 36 percent report their company's IT departments are having either "significant difficulties" (26.6 percent) or "can't keep up at all" (9.2 percent).

The quick, flexible and responsive application delivery is needed to support organizations in a violent business market. The software engineering discipline has been exploring agile software development since 1990s and several agile software development methodologies, such as Extreme Programming (XP) and Scrum, get a lot of attention from practitioners because of the potential to improve customer satisfaction, shorten development time and accommodate rapidly changing requirements (Williams and Cockburn 2003). The true nature of the agile software delivery was studied by both researchers and practitioners (Cockburn, Highsmith and Boehm 2001; Highsmith, Cockburn and Boehm 2001). But no empirical studies were done because of lack of effective measurement. Lee and Xia (Lee and Xia 2005) contributed to this perspective and developed a measure of the ISDP team flexibility. Lee and Xia (Lee and Xia 2005) argue that ISDP team flexibility includes two dimensions, response efficiency and response extensiveness. But will flexibility increase costs of the project? Will flexibility decrease the quality of the product? This study tries to answer this research question of "how will ISDP team flexibility affect project performance".

"Agility" and "Flexibility" are often used interchangeably in the literature. Agility is a response to the challenges posed by a business environment dominated by change and uncertainty (Kassimand Zain 2004). Flexibility is a complex, multidimensional construct. Flexibility can be measured in terms of scope and efficiency (Duncan 1995; Nelson and Ghods 1998). Patten et al. (Patten, Whitworth, Fjermestad and Mahinda 2005) propose a flexibility framework by combining three related aspects, anticipation, agility, and adaptability because the definition of flexibility is not one size fits all. Following Pattern et al.'s framework, this paper treats agility as one dimension of flexibility.

The ISDP team's flexibility is defined as the ISDP team's ability to effectively and efficiently respond to business and technology changes (Lee and Xia 2005). ISDP team flexibility is viewed as a project-level organizational capability that utilizes project resources to respond to the changing business and technology contexts. In the Information Systems Development (ISD) context, Lee and Xia (Lee and Xia 2005) identified major business and technology changes that demand the ISDP team be flexible and developed a measurement scale of the ISDP team flexibility along two dimensions: Response Extensiveness and Response Efficiency. Extensiveness measures the extent of ISDP team response and is related to response scope, range and variety. Efficiency measures the effort required by the ISDP team to respond to change and is related to time, cost, and difficulty. This paper examines the ISDP flexibility issue from a capability development perspective. Drawing from the manufacturing agility literature, this paper argues that the ISDP team develops flexibility because of the anticipation and reaction capabilities embedded in the agile software development practices. How does the resulting ISDP team flexibility affect project performance? This paper proposes that the team's problem solving competency is a critical mediator between the ISDP team flexibility and the project performance. A quantitative study is proposed to collect empirical evidences for this research model. Practitioners can benefit from this research by understanding why the agile software development methods work and identify some possible ways to repeat quick application deliveries by purposely cultivating the ISDP team's capabilities and problem solving competency.

RESEARCH MODEL

Both organizational change literature and manufacturing flexibility literature report on the mechanisms that lead to the flexibility in responding to changes. In the organizational change literature, Eisenhardt and Brown (1997) explore organizations that can continuously change. There are three key findings about the managers' practices in their case studies. Managers with successful multiple-product innovations form current projects by combining clear responsibilities and priorities with extensive communication and freedom. Managers probe into the future with a variety of low-cost experiments. Finally, they link current products to future ones using predictable product intervals and choreographed transition procedures. In order to be prepared for the volatile market, organizations have to be flexible and continuously be prepared for change. Flexibility is a frame of mind. It comes from a way of looking at the market. Flexible organizations have the ability to foresee potential problems and opportunities and strive to avoid the problems and seize the opportunity. IT can be a big part of what makes a company agile. In order to deliver the system in a flexible way, IS development teams must be able to foresee the possible risks, problems and threats in the development. When problems arise, IS development teams must be able to react to the problems in an efficient and effective way.

In the manufacturing flexibility literature, Verganti (1999) argues that the early product design is critical for the project flexibility. Product development team must have both the anticipation and reaction capabilities to achieve the desired flexibility. Anticipation capabilities are the capabilities to anticipate needed information during the early phase of product development. Reaction capabilities are the capabilities to introduce changes late in the process at a low cost and in a short time, to cope with unexpected constraints and opportunities. Several principles of Extreme Programming (XP) remind the developers and projects managers that user needs evolve. The close interaction between the developers and users enables the developers to anticipate the future user needs. The frequent release and formal or informal reviews give the developers rich feedback for the users' needs. XP advocates developing a team centered on a motivated person. This person should have not only compassions but also the rich experiences on this system or similar projects. Once the changes are needed, this motivated person in the ISDP team should have the capability to develop a strategy for the team and react to the changes quickly and at a low cost. XP emphasizes the management support for the development team so that abundance of resources can support the needs of the development team. Face-to-face communications in XP can facilitate the quick reaction process. Both the organization change literature and the manufacturing flexibility literature elaborate that anticipation and reaction will lead to the flexibility.

According to the capability-based perspective, organizations have dynamic capability if a firm is able to integrate, build and reconfigure internal and external resources, competences and capabilities to address rapidly changing environments (Grant 1996). An ISDP project team will have a high level of efficacy on their solution strategies when the problems can be solved in an effective and efficient manner. This problem-solving competency is developed when a norm of the solution strategies is developed. By solving the problems in a fast and efficient way, the ISDP team can serve the customers' needs better and naturally lead to successful IS project performance. Based upon the above argument, the research model is proposed (please see Figure 1). The next section provides the development of each hypothesis.

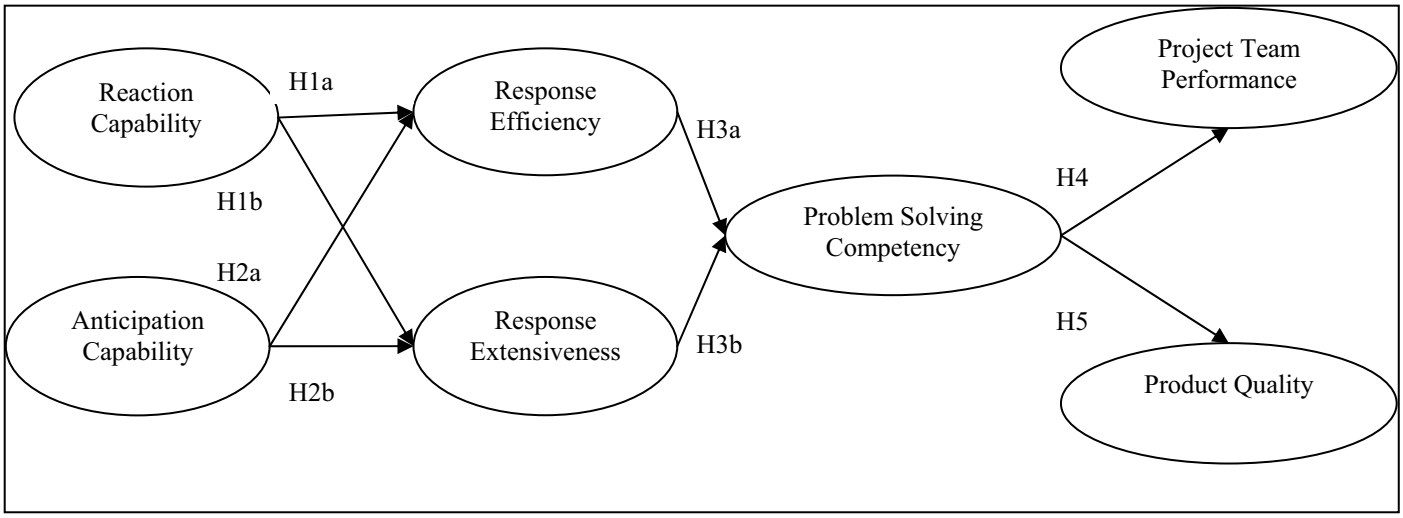

Figure 1: Research Model

HYPOTHESES DEVELOPMENT

In this section, we will look at the various hypothesis of this research. Before each hypothesis is introduced, the details of how we reach the hypothesis will be examined The manufacturing flexibility literature emphasizes that it is critical to manage the early phase of a project to obtain the highest performance in the product development as a whole (Verganti 1999). Anticipation capabilities can give the development team's mental readiness for some possible problems, get prepared for the difficulties, and incorporate the uncertainties and changes (Verganti 1997, 1999). The ISDP team should learn to anticipate the technological and business changes identified by Lee and Xia (2005). The ISDP team can learn to anticipate the possible technological changes by watching recent technological innovations and managing the technology risks. The ISDP team can work with the users to have a proactive thinking mind and consider the possible business changes and leave more choices to them if the changes really happen. When the technological and business changes occur and new requirements are demanded to be incorporated into the system, the ISDP team can find a solution more quickly because of the proactive thinking - and some available choices enable the ISDP team to respond in an extensive way when the new features or changes have to be added to the system. Therefore it is proposed that

H1. Anticipation capability will have a positive relationship with the ISDP team's flexibility.

H1a: Anticipation capability will have a positive relationship with the ISDP team's response efficiency.

H1b: Anticipation capability will have a positive relationship with the ISDP team's response extensiveness.

Although anticipation capability is important for getting ready for the changes, the ISDP team also needs to have the capability of reacting to the changes quickly and in a cost-effective way. This is called the reaction capability (Verganti 1999). The ISDP team that reacts quickly to changes usually has resource flexibility and strong communication and coordination capability. The resource flexibility involved in the ISDP development process includes highly skilled users and developers, and integrated technology tools. Highly skilled users and developers have rich experiences in the coming business and technology changes and appropriate decisions can be made based upon past experiences. Therefore the response extensiveness can be achieved. In addition, integrated technology tools such as teleconferencing and project management tools can bring all the stakeholders on the same page. The new changes can be implemented in a efficient way. In addition intensive team communication and coordination can accelerate the integrated problem solving during the change process. The above argument supports the following hypotheses.

H2. Reaction capability will have a positive relationship with the ISDP team flexibility.

H2a. Reaction capability will have a positive relationship with the ISDP team's response efficiency.

H2b. Reaction capability will have a positive relationship with the ISDP team's response extensiveness.

The ISDP project can respond to the changes effectively because they keep abreast of recent technology and have the evolving users' needs in mind. The ISDP project team with flexibility has effective communications within teams and with users. It is not surprising that the ISDP team with the capability to respond to the changes in an extensive way has the competency in solving problems that arise in the project. At the same time the ISDP team that has the capabilities to respond to the changes in an efficient way can have few mistakes and resource waste because of rich experiences in the past projects and insights on the nature of the changes and key barriers of the change process. In this way, the ISDP project team is competent in solving problems in the economic sense. Because the ISDP team with flexibility can solve the problems within a satisfying scope and reasonable cost, the ISDP team's flexibility can lead to the team's competency in problem solving.

H3. The ISDP team's flexibility will have a positive relationship with the team's problem solving competency.

H3a. The ISDP team's response efficiency will have a positive relationship with the team's problem solving competency.

H3b. The ISDP team's response extensiveness will have a positive relationship with the team's problem solving competency.

Problem solving activities are well embedded in the project process. An ISDP project team that has a high level of problem solving skills can utilize available resources in ways that facilitate the favorable outcomes. An ISDP project team with problem-solving competency can solve the problems in an efficient and effective way and spend the efforts to control and deal with other types of risks in the projects. In this way, project goals are more likely to be achieved within time and budget. Therefore, it is proposed that

H4. Problem solving competency will have a positive influence on the project performance.

An ISDP project team with flexibility has the users' needs in mind and stays alert to the evolving user needs. When an ISDP project team has a high level of problem solving competency, the developers can analyze the needs extensively and interpret the users' needs with their understanding of the sources of the changes. Naturally the information system will address the users' needs and be more user-friendly and have more powerful functions. This argument supports the following hypothesis:

H5. Problem solving competency will have a positive influence on the product quality.

RESEARCH METHOD

A survey design is selected for testing the proposed model based on existing operationalizations of measures of constructs. A project-level questionnaire was mailed to randomly selected software development team members who are alumni of a University in China. This group of software development team members are selected because they represent diversified industries that conduct IS development. This university in China has a high reputation in IT/MIS undergraduate education and its graduates are highly recruited by diversified industries.

The purpose of the questionnaire is to understand how an IS team achieve the team's flexibility and the relationship between the team's flexibility and the project performance. The participant's project does not necessary adopting any particular agile software development methods. Almost all the ISDP teams try to be flexible and take several practices to address the flexibility issues.

Constructs

Anticipation capability is reflected in the team's practices (Verganti 1997, 1999). Anticipation capability is reflected in systemic learning, team working and the use of proactive tools. The participant is asked to indicate to what extend the participant's project adopts the listed mechanisms. Reaction capability is measured by asking the participant to indicate if the project has adopted the listed mechanisms such as involving highly skilled developers in the projects, the use of rapid prototyping and the overlap between development stages, etc. The measure scale is from 1 "Not at all" to 5 " To a large extent." These items have been employed in previous studies (Verganti 1997, 1999)

Team problem–solving competency is measured by the extent of agreement (1 - strongly disagree, 5--strongly agree) with five statements from a previous study (Aladwani 2002). One example statement is "compared with most other IS projects in our organization, our project was better in identifying problems". Requirements uncertainty and technological uncertainty serve as control variables and are adopted from a previous study (Nidumolu 1996). Requirement uncertainty includes three dimensions, requirement instability, requirement analyzability and requirement diversity.

ISDP flexibility has two key dimensions; response extensiveness and response efficiency with items from a previous study (Lee and Xia 2005). The measurement of ISDP team response extensiveness includes 11 items such as "To what extent did

the project actually incorporate changes in system scope?" The measure of ISDP team response efficiency includes 11 items such as "How much additional effort was required to incorporate the changes in system input data?"

Project performance must represent many aspects of the development process and be recognized as important by the past literature. The measure of project performance employed includes seven items (ability to meet project goals, expected amount of work completed, quality of work completed, adherence to schedule, adherence to budget, efficient task operations and high work morale) and requires the respondents to answer based on the most recently completed projects (1 – Never, 5 – Always) (Nidumolu 1995).

Product quality comes from Nidumolu (1995). The measure includes three dimensions, operational efficiency, flexibility and responsiveness and has 12 items. One sample item is "The software is reliable" and the measurement scale is from "strongly disagree" to "strongly agree".

Factor analysis will be used to assess the construct validity. Cronbach's alpha test will be used for reliability. Partial Least Square (PLS) will be used for data analysis.

CONCLUSIONS

This paper addresses the research question "How the ISDP flexibility affects IS project performance." ISDP flexibility becomes essential due to technology and business changes in the turbulent market (Lee and Xia, 2005). Although ISDP flexibility is important, it might have positive effects on project performance because an ISDP team can deliver the system in a timely manner. However it might have negative effects because of increased costs in communication and changing product features. In addition, while the ISDP team's flexibility is critical in the project, IS project managers who strive to work in a flexible and consistent manner should pay close attention to cultivate the project team's problem-solving competency. Both anticipation capability and reaction capability can enhance the development team's flexibility and then lead to the team's problem solving competency. IS project managers will find that it is about the ISDP team working together effectively, breaking barriers to communication, and focusing on value-added activities that lead to successful development. It is about working side by side, not simply handing off documents. It is about managers actively managing projects instead of writing status reports. It is about developers and stakeholders working together to develop a realistic plan, not acting out roles to develop complex schedules.

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