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Abstract

Surveys on system development (SD) project performance suggest that while much improvement has been made in SD technology, the project success rate remains low. SD research based on the socio-technical perspective suggests that three sources of socio-technical change have a bearing on the performance of SD projects: business requirements, development technology, and development procedures. To enhance project effectiveness, SD teams need to be flexible in the face of the constant changes from business and technical environments where they operate. The construct, SD Team Flexibility, is used to describe an SD team's capability to utilize project resources to respond to changes from socio-technical environment. In this study, we propose that the SDTF has profound impact on the effectiveness of SD project. Furthermore, drawn on social capital view, this study explores the factors explaining the variation of SDTF among SD teams. Finally, this study posits that the impact of SDTF on project performance is mediated by team efficacy. A model depicting the nomological relationships between the constructs is developed. Research methodology that this study is used will be described. This paper concludes with potential research and practical implications.

Keywords: System Development Team Flexibility, Social Capital, Team Efficacy, System Development Project Performance

1   RESEARCH PROBLEMS

According to a survey conducted by the Standish Group, among all the information systems development (SD) projects with budgets exceeding \$2.5 million, only 16.7% were successful (Pattit & Wilemon 2005). The survey also showed that US investment in SD projects in 2001 was four times that reported in 1990, but with a success rate of only 28%. Among 2000 various SD projects, a quarter were cancelled before completion, amounting to cancellation fees of over US\$6.7 billion. Among the successful projects, 80% of the budget was used for debugging. These statistics suggest that while much improvement has been made in SD technology, the success rate remains low. For an SD company, SD success rate is vital. Project failures not only waste resources and lead to foregone business opportunities, but also impair reputations and profits.

SD research based on the socio-technical perspective suggests that the performance of SD projects is subject to constant changes in both social and technical environments where SD teams operate. Three sources of socio-technical change are identified: business requirements, development technology, and development procedures (Anandhi 2000, Jiang & Klein 2002). Firstly, changes in terms of business requirements stem from changes in business objectives, markets, working environments, or government regulations. These changes lead to necessary alterations of information system requirements and delays of their development schedules. Consequently, software costs rise due to these design alternations and deadline pressure. Secondly, changes in system development technology means the new introduction of the later development technology application. System development technology refers to the know-how and techniques required for developing information systems (Wade & Hulland 2004). Such development technology encompasses aspects such as programming languages, programming tools, information technology structures, system development techniques, and the integration technology required for corporate information systems. The innovation of system development technology can become a major risk in the SD field that can result in project failures if project teams lack the abilities to evaluate and apply new development technologies (Schmidt et al. 2001). Finally, changes in development procedures refer to customizing development processes based on individual project requirements (Nidumolu & Knotts 1998, Jalote 2002). Any requested customization requires adjustments to preexisting development procedures (Humphery 1989, Jalote 2002). The purpose of customizing procedures is to achieve a project goal by using organizational resources more efficiently. Poorly designed procedures impede work efficiency and increase labor costs, thereby affecting project results in the long run.

Overall, the challenges faced by development teams include catering to constant changes from clients' business requirements and choosing suitable tools and procedures for SD projects. The construct, system development team flexibility (SDTF), is used to describe the system development team's ability to respond to changes from sociotechnical environment (Lee & Xia 2005). In this study, we argue that the SDTF has profound impact on the effectiveness of SD project due to the fact that SD

teams are subject to a variety of uncertainties in the course of systems development. As shown in Figure 1, this study also explores the factors explaining whether a SD team is high or low on SDTF. Specifically, a social capital view is the primary theoretical lens used in this study to explain external conduits with valuable resources leading to the variation of SDTF among SD teams. Finally, this study posits that the impact of SDTF on project performance is mediated by team efficacy.

The remainder of this paper is organized as follows. In the next section, we review the extant literature related to the constructs included in the research model. Subsequent sections describe the research methodology. This proposal concludes with a discussion of the contributions and limitations of this paper.

2   LITERATURE REVIEW

2.1   System Development Team Flexibility

Flexibility has been widely used in the field of strategic management and is referred to as the agility of being able to change course to take advantage of opportunities and to side-stepping threats, facilitate rapid responses (Sanchez 1995; Volberda 1996), and adapt to the unanticipated environmental changes (Aaker & Macarenhas 1984). Despite its extensive use in different organizational contexts, research focusing on the construct of flexibility at group level in lieu of systems development is limited to two relevant studies. Lee and Xia (2005) first analyzed SDTF and proposed that the core of SDTF lies in the extent to which the SD team extensively and efficiently in response to business and technical changes. While the extensive flexibility refers to the range and variety of a project team's responses to organizational and technological changes, the efficient flexibility refers to the costs and time involved when a team responds. Teams able to respond to a wide range of necessary changes were graded higher in terms of flexibility, and judged more able to save on additional costs. In their study, seven business changes and five technical changes were identified through interviews with experts. Based on the findings, a scale measuring how extensively and efficiently teams responded to business and technological changes were developed.

Unlike Lee and Xia, who measured team flexibility indirectly, Yang and Chang (2007) explored the structure and specific substance of SDTF through three rounds of Delphi survey. The survey results showed that SDTF factored into three sub-constructs: business requirements flexibility, development technology flexibility, and development process flexibility. Business requirement flexibility refers to a development team's ability to both analyze the impacts of business requirement changes on system development and lay out a solution plan. Development technology flexibility is the ability to utilize and integrate the knowledge and techniques of different system development technologies. Development process flexibility refers to a team's ability to customize development procedures based on individual project needs. Consistent with Yang and Chang's (2007) scheme,

SDTF in this study is conceptualized as a multifaceted variable formed by these three first order constructs. Hence, system development team flexibility (SDTF) refers to a system development team's ability to utilize project resources to respond to changes from social and technical environment in the course of systems development.

2.2 External Social Capital Conduits

Social capital theory argues that networks of relationships constitute a valuable resource for the conduct of social affairs. Thus, social capital can be viewed as a set of resources for social action through a network of relationships that are located within or without the focal social unit. Consistent with Nahapiet and Ghoshal (1998), social capital refers the totality of resources embedded within the network of relationships possessed by a social unit. Social units which possess critical social capital can have more timely, relevant, and diverse information that may be critical to group effectiveness. Extensive social linkages also allow the focal group to have greater access to tangible or intangible resources, and greater visibility, legitimacy, or sponsorship in times of difficulties. (Ancona & Caldwell 1992, Burt 2000, Seibert et al. 2001). In group context, these are the two main sources that make social capital available to the focal group: internal and external (Oh et al. 2004, Oh et al. 2006). While the internal sources of social capital involve the group's internal social structure that defines the relationships among leaders, group members, and subgroups, external sources entail the extended social relationships that outline the linkages to other social units located outside the boundary of the focal group. In this study, external social capital sources are particularly chosen on the grounds that much less research has focused on it than those within the group (Ancona & Caldwell 1992).

As the availability of external social capital lies in relationships entrenched in an intra- or extra-organizational social structure, extant literature has distinguished conceptually two dimensions of external relationships: vertical and horizontal (Ancona & Caldwell 1992, Seibert et al. 2001, Oh et al. 2004, Oh et al. 2006). Vertical relationships refer to the reciprocal and trusting affiliation that the focal group has cultivated with its higher-ups, while horizontal relationships means the similar working relationships that the focal group has established with other social units (i.e. functional areas, business units, or groups) in the organization (Seibert et al. 2001, Oh et al. 2004, Oh et al. 2006). While extant research makes significant contribution in exploring the sources of external social capital, a relatively narrow view was taken, stressing particularly on boundary-spanning activities located within organization and overlooking those embedded outside the organization. Research shows that other social units outside the organization may also represent an important source for social capital (i.e. consultant companies, vendors, industrial associations, and profession association etc.) (Swanson & Ramiller 1997, Damsgaard & Lyytinen 2001). In this research, market relationships is thus added as the third dimension to the scheme of social capital and is referred to as focal group's social connections to the extra-organizational parties.

2.3   Team efficacy

Rooted in social cognitive theory, team efficacy is an extension of Bandura's (1986) work on self-efficacy, which refers to an individual's belief in his or her ability to accomplish a task. Team efficacy refers to a group's shared belief in its perceived capability that can successfully perform certain group tasks (Jung & Sosik 2003, Gibson & Earley 2007, Tasa et al. 2007). Despite extensive attention has been paid to team efficacy, the extant research takes two different perspectives in the conceptualization of the construct (Gibson et al. 2000, Gully et al. 2002, Jung & Sosik 2003). One stream of research examines team efficacy at the individual level, articulating that team efficacy is rooted in self-efficacy and thus can be reflected as the aggregation of individual perceptions of confidence on a group's capability (Zellar et al. 2001). This conceptualization of group belief has been criticized that it fails to acknowledge the group as an entity and to account for dynamic social processes that occur within groups (Lindsley et al 1995, Jung & Sosik 2003, Gibson & Earley 2007). Therefore, cautions need to be taken when applying the findings at the individual level of analysis to group contexts (Klein et al. 1994, Gully et al. 2002).

The other stream of research conceptualizes team efficacy as a group-level construct, representing group members' shared belief on a group's capabilities, resources, and constraints. This stream of study argues that efficaciousness perception is more than the sum of the individual members' cognitions about the group (Lindsley et al. 1995, Fuller et al. 2007, Gibson & Earley 2007). In group context, members must coordinate their actions, and are likely to be influenced by the beliefs, motivation, and performance of their coworkers. Therefore, efficacy at group-level studies has been viewed as emergent and collective properties of the group resulting from dynamic social processes that take place among members of the group (Lindsley et al. 1995, Gully et al. 2002). By knowing the differences between these two streams, the definition of team efficacy in this study reflects the second of these perspectives.

Despite similarity at the level of analysis, group-level research differs in its focus of task specificity. These researchers have captured beliefs about specific group outcomes such as the certainty that the group can perform on a particular group task objective or on a specific trial of a task (Parker 1994, Gully et al. 2002). Performance beliefs that are narrowly referred to as specific group task are readily being applied in laboratory experiment and difficult being generalizable to field settings because in most cases tasks are interdependent (Van de Ven 1976, Gibson et al. 2000). However, when a task is broadly defined, the capabilities required for successful completion are less clear than when a task is narrowly defined (Gibson et al. 2000). Thus, Gibson et al. (2000) suggest that team efficacy is conceptualized as a perception in the capability of the group to meet a task objective.

After reviewing the literature, two characteristics that define team efficacy surface: perception sharedness and task specificity. Sharedness of perceptions is an essential characteristic of team efficacy because it clearly distinguishes group's performance belief from that of individual. Members

are likely to be influenced by the beliefs, motivation, and performance of their co-workers. The collective sense of efficacy thus emerges from common exposure of members to the process of social influence and social comparison (Gully et al. 2002). Appropriate belief unit is another important determinant of team efficacy. Efficacy perception focusing on overly specific tasks inhibits generalizability. Based on the past group-level research and Gibson et al's suggestion, team efficacy in this context of system development, is defined as the shared belief in its perceived capability to successfully perform system development task objective.

3   RESEARCH HYPOTHESES

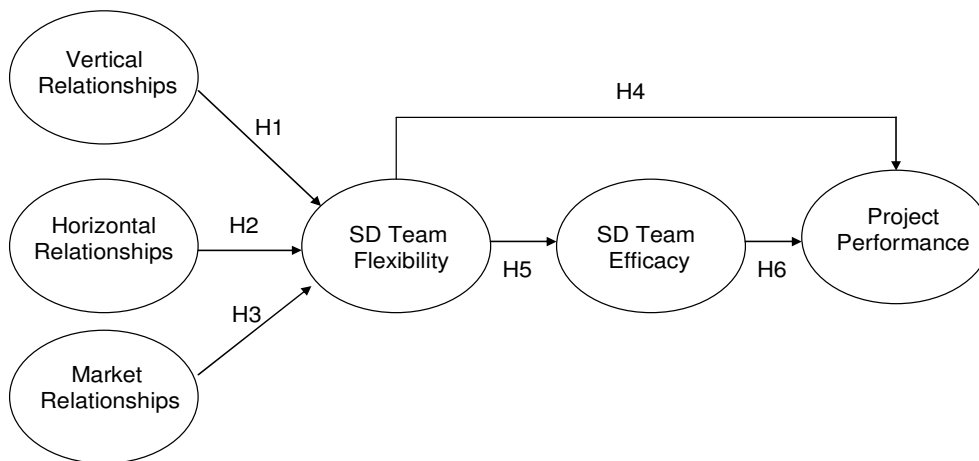Figure 1 schematically shows the research model on which various theoretical perspectives are drawn.

Figure 1.   Conceptual Model

3.1   Vertical Relationship and STDF

In a rational organizational structure, the high level managers hold a position that can provide necessary resources (i.e. information, financial, and administrative support). When clients require modifying system requirements due to business changes, upper-level managers may provide information regarding the level of commitment and support that the SD firms will invest, which facilitates an SD team's ability to effectively evaluate the impacts of systems requirement changes on the SD project, determine if the changes are reasonable, and finally come up with a solution plan if needed. When the team is short of the knowledge or skills in terms of SD technologies and process customization that are needed for the project, high-ups support could recruit team members who are skilled in SD technologies and provide organizational resources that meet the unique development process needs of SD projects. Based on the aforementioned argument, we hypothesize the following:

H1: Vertical relationships that a SD team holds are positive associated with SD team flexibility.

3.2 Horizontal Relationships and STDF

Researches suggest extensive lateral relationships with other social units (departments or groups) within the organization facilitate the exchange and transmission of expertise and knowledge (Cohen & Levinthal 1990, Cummings 2004). SD teams that share reciprocal relationships with other departments or SD teams in the organization allow them to receive timely and relevant information regarding the know-how that enables the team to analyze the impacts of business requirement changes on system development and to lay out a solution plan. Moreover, reciprocal relationships create a sense of partnership that renders other departments of SD teams willing to share the risks and responsibilities, which prompts them to share the know-how and even human resources related to emerging SD technologies and SD process that the focal team does not possess. Based on the above argument, we hypothesize:

> *H2: Horizontal Relationships that a SD team holds are positively associated with SD team flexibility*

3.3 Market Relationships and STDF

Independent third parties (e.g. professional associations, industry associations, vendors and consultants) have been regarded as a "knowledge marketplace" from which innovative expertise and knowledge are disseminated and hence seen as an essential conduit through which the focal SD team can assess resources (i.e. SD expertise and knowledge) that are unavailable in the organization (Swanson & Ramiller 1997). For example, vendors can provide novel SD technologies that the SD team needs for the current projects. Consulting companies may provide their experiences and knowledge in dealing with systems requirements changes as well as SD customization. Based on the abovementioned argument, we hypothesize the following:

> *H3: Market relationships that a SD team holds are positive associated with SD team flexibility.*

3.4 SDTF and Project Performance

Researchers have espoused that SD team's expertise and capability have profound impacts on project performance (Cerveny et al. 1990, Jiang et al. 2000, Aladwani 2002). SD teams with high flexibility mean that they could effectively cope with unanticipated systems requirement changes from clients. The teams could proficiently analyze the potential impacts on the project and quickly come up with a solution that can meet the client's need. High on SDTF also means that the SD team possesses substantial IT expertise. Past research suggests that SD teams with appropriate technical skills and experience in integrating a variety of technologies is a significant determinant of the project performance (Jiang et al. 2000, Aladwani 2002). Tziner and Eden (1985) reported that for tasks that were highly interdependent such as in the case of systems development, group performance was related positively to the summed capabilities of the team. SD teams with high process flexibility can

accurately evaluate project risks and tailor schedules and resources to the unique requirements of each project and thus can effectively reduce the amount of rework that occurs during the project life-cycle (Deephouse et al. 1995) and improve the overall project performance (Nidumolu & Knotts 1998). Based on the aforesaid argument, we therefore hypothesize:

H4: STDF is positively associated with project performance.

3.5   SDTF and Team Efficacy

Team capability is being argued as a strong predictor for team efficacy (Scott-Young & Samson 2006). More specifically, an SD team with high team flexibility is more likely to enhance their team belief in dealing with all the unpredictable changes than the team that carries low team flexibility. As such, high SDTF team is more likely to perceive that it is capable of successfully performing system development tasks (Hecht et al. 2002). Based on the abovementioned argument, we hypothesize the following:

H5: STDF is positively associated with team efficacy.

3.6   Team Efficacy and Project Performance

Research has found that team efficacy has profound impacts on team performance (Lindsley et al 1995, Jung & Sosik 2003). SD team with high efficacy means that it holds high belief about its capability in solving problems in the course of systems development. Hecht et al. (2002) found that a team with a thinking-we-can confidence was a robust antecedent to team success. Consistent with their study, Gully et al.'s (2002) recent meta-analysis of a variety of team types confirmed that team efficacy exhibits a strong positive relationship with team performance. Team actions are influenced by the belief of the team and thus, the higher the team's belief on accomplishing the designated SD projects, the more positive is the final project outcome. Based on the aforesaid argument, we therefore hypothesize:

H6: Team efficacy is positively associated with project performance.

3.7   Team Efficacy as a Mediating Factor

Collective efficacy is posited as a mediating variable that explains the mechanism underlying the relationship between team ability and team performance (Bandura 1997). In effect, team efficacy acts as a regulator of team behaviors (Kirkman & Rosen 1999). Efficacy research argues that efficacy beliefs determine whether people will engage in certain behavior, what they choose to do and how much effort they put into it (Bandura 1997, Tasa et al. 2007). Therefore, even though a group may possess sufficient capabilities, the use of the capability depends on the thoughts to execute the course of action required to produce given attainments (Gibson & Earley 2007). Consequently, teams with high sense of efficacy belief tend to actively engage in designated tasks. Hecht et al. (2002) found that

team efficacy mediates between team performance and team ability. Based on the abovementioned argument, we hypothesize the following:

H7: The effect of SDTF on project performance is mediated by team efficacy

4 RESEARCH METHODOLOGY

This study uses system development teams as the unit of analysis. The literature reviewed and the related constructs are derived from the same level of analysis. This study will systematically follow steps first to develop the construct validity and reliability of the key concepts included in the research model, and then to test nomological relationships. In term of construct development and refinement, the study will follow Moore and Benbasat (1991) and Churchill's (1979) scale development procedure.

Pertinent scales will be reviewed for their coverage of content and psychometric properties. Existing measures that have a demonstrated reliability and validity will be used. For the new constructs such as Vertical Relationships, Horizontal Relationships, and Market Relationships where scales do not exist, a pool of items will be generated to cover the domain of this construct. A Q-Sort procedure will be performed to check the content validity of the instrument.

A pilot test for the instrument will be performed on a representative sample of the target population using conditions similar to those anticipated during actual data collection. Reliability and validity tests will be performed to ensure that all areas of the domain of interest are covered and that the items truly measure what they are supposed to. Respondents will also be asked to report problems encountered while filling out the questionnaire. Feedback is thus obtained from participants in the pilot test regarding items selected, sentence structure, and interpretation of constructs. The instrument will be modified accordingly.

Due to the fact that this study uses the team as the unit of analysis, members of SD teams in the top ten SD companies in Taiwan will be targeted as the main respondents. Cronbach's Alpha and factor analysis will be applied to assess construct reliability and validity for the measurement model. Partial Least Square analysis will be used for path analysis among the exogenous variables and endogenous variables.

5 POTENTIAL CONTRIBUTIONS

5.1 Academic Contributions

1. Scale development for new constructs related to external social capital.
2. Enrich the external social capital theory by adding Market Relationships as an additional dimension to the existing theoretical structure.

3. First MIS article that applies social capital perspective in the examination of impact of social resources on team flexibility capability.

4. Explore a potential mediating factor that would have effect on the relationship between SD team flexibility and project performance.

5.2   Practical Implications

1. Provide theoretical basis on which SD teams can build up their flexibility.
2. Provide a list of factors that may influence the effectiveness of SD project.

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