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ABSTRACT

Information System Development Project (ISDP) teams continue to face tremendous challenges because of the need of innovative solutions for business changes. Based on the results of previous studies, this research proposed participative culture and expertise coordination as antecedents to ISDP Team flexibility, which in turn leads to successful project performance and product quality. The empirical analysis of 119 survey responses indicated that expertise coordination has positive and significant effects on both response extensiveness and response efficiency to business changes but participative culture only affects response extensiveness significantly. Both the ISDP Team response extensiveness and response efficiency to business changes were found to have significant impacts on product quality but response efficiency only affected project performance in a significant way.

Keywords

Team Flexibility, Information Systems Development

INTRODUCTION

IS projects have been well known for the high failure rate (Schwalbe, 2009; Standish Group International, 2009). From the socio-technical perspective, the problems that the information systems are aimed to solve are changing and ambiguous. Failure to respond to the socio-technical changes often results in a system product that is irrelevant to user needs and leads to project failure. As the Information Systems Development Project (ISDP) team becomes more flexible, project performance tends to increase and product quality tends to be better. Although it is widely recognized that the ISDP team flexibility is important (Byrd & Turner, 2000; Lee & Xia, 2005), little has been known about the determinants of ISDP flexibility.

The ISDP team flexibility is defined as the collective ability to effectively and efficiently respond to business and technology changes (Lee & Xia, 2005). ISDP team flexibility is viewed as a project-level organizational capability. Of particular interest in this study is the ISDP team flexibility to business changes.

The need of innovative solutions to unique business problems in the system development process requires the need for expertise. The importance of expertise coordination in software development has been recognized in the literature (Faraj & Sproull, 2000). However, the mere presence of domain experts, methodology experts and project management experts in a software development team is not sufficient for project success. Expertise only can be effective utilized when a coordination mechanism is in place (Faraj & Sproull, 2000). Expertise coordination has been found to have a positive influence on project performance (Akgun, Byrne, Keskin, & Lynn, 2006; Faraj & Sproull, 2000). While expertise coordination generates effective solutions for business problems, the quick implementation of the selected solutions is critical for response effectiveness and efficiency.

Multiple agile methods have emphasized best practices such as stand-up meetings, collective ownership, team diversity and team autonomy, etc (Lee & Xia, 2010; Maruping, Venkatesh, & Agarwal, 2009). These practices enable the team members to actively participate, exchange opinions, anticipate changes and implement changes quickly. Team participation has been identified as an important factor for increasing shared goals and the level of engagement (Hulsheger, Anderson, & Salgado, 2009). An important question relates to how the participative culture facilitates the ISDP team's flexibility to business changes and leads to the successful project outcomes. In the context of turbulent business environment, active participation of experts enables the ISDP team to assimilate prior related knowledge and expertise, and generate new knowledge and apply to solve the emerging problems. Innovative solutions are needed and have to be implemented quickly.

The purpose of this study is to understand how expertise coordination and participation enhances the ISDP team flexibility capability to respond effectively and efficiently to the business changes and ultimately lead to successful project outcomes. This research is expected to contribute to the literature by proposing a model based in prior results to explain how expertise coordination and a participative culture enable ISDP team flexibility and ultimately affect performance in software development projects. In addition, this study contributes to the team flexibility literature by providing an in-depth understanding of two particular antecedents of team flexibility and the mediating role of team flexibility on project outcomes. The turbulent external project environment, diverse experts in subject matters, domain knowledge and methodology knowledge, and participative internal culture give a unique context for the study of ISDP teams. We tested the model by a questionnaire survey involving 119 ISDP teams which have to accommodate business changes in the development process.

BACKGROUND LITERATURE

2.1 Information Systems Development Project Team Flexibility

Flexibility refers to being adaptive for environmental changes. There are two major streams of IS/IT flexibility research reported in the literature. One stream focuses on designing flexible IT architecture and infrastructure and how the embedded flexibility supports strategic changes in response to changing market conditions (Byrd and Turner, 2000). Another stream moves the focus to the software development processes and explores how the utilization of new design tools and human expertise increase team flexibility to business and technological changes (Maruping et al. 2009).

Software development is a highly complex task and a social process, since many specialized functions collaborate on one project (Curtis, Krasner, & Iscoe, 1988). Most software projects involve various types of uncertainty to a degree. The software project uncertainty has been categorized into requirement uncertainty and technological uncertainty (Nidumolu, 1995). ISDP teams should utilize project resources to respond to the business and technology changes. Lee and Xia (2005) adopts the capability-based perspective and treats the ISDP team flexibility as an organizational capability in response to changes. Lee and Xia (2005) defined the ISDP team flexibility with two dimensions: response extensiveness and response efficiency. Response extensiveness is related to project scope dimensions such as range and variety. Extensive responses to the changing user requirements and generating a large range of system output have been critical goals for ISDP teams (Barki & Jon, 1989, 1994; Baroudi, Olson, & Ives, 1986; Ives & Margrethe, 1984). Response efficiency includes dimensions such as time, cost and difficulty. This efficiency dimension captures ISDP team flexibility in terms of the amount of additional effort required by the ISDP team to manage the business and technology changes. The effective use of these techniques strives to achieve high product quality and user satisfaction.

2.2 Participative Culture:

Participative Culture represents a style or approach to managing the team with the attempts to maximize human potential and encourages team involvement within the team and related stakeholders. Participative cultures are thought to lead to higher individual work performance, higher job satisfaction and increased organizational effectiveness(Ledford & Lawler, 1994; Wagner & Gooding, 1987). Multiple processes such as suggestion systems, team meetings and invitation to feedback are used to encourage participation (Guthrie, 2001).

Project members share ideas and insights in the participative culture. However, divergent thought and creative ideas still need further interaction, critical analysis and collaboration to figure out the most workable ideas for the emergent problems. Interactions between experts in various domains will augment the team's capacity for making

novel linkages and associations between knowledge areas (Cohen & Levinthal, 1990). It is suggested that the more individuals are aware of others' capabilities and knowledge, the stronger the team's ability to recognize the value of new information, assimilate and apply to problem solving. Participation stimulates the exchange and integration of information and ideas, reduce the resistance to changes and facilitates the commitment to team's responses to changes. Participation also facilitates learning through the sharing and combining of knowledge. Participation generates the social support for the new changes that will be pursued to solve the problems (De Dreu & West, 2001).

2.3 Expertise coordination

Faraj & Sproull (2000) define expertise coordination as a team-situated process for managing knowledge and skill dependencies. Expertise can be located in the team with the team members and outside of the team in the form of documents, knowledge repositories or functional experts. In addition to knowing where expertise is located, it is important to recognize when the expertise is needed and bring the experts in quickly. Faraj and Sproull (2000) propose that expertise coordination consists of socially shared cognitive processes that develop and evolve in order to meet the demands of task-based skill and knowledge dependencies. When team members apply expertise to meet task demands, they activate and reinforce these processes. Expertise coordination processes require differentiated knowledge and skills possessed by team members and patterns of heedful interactions that support the application of these skills and knowledge where needed.

When processes are distributed, heedful and emergent, the expertise coordination can be effective. The ISDP project team has members from diversified functions. The communication process can be heedful since they share overlapping task knowledge and can take joint actions to handle the changes. The processes are also emergent since there are no pre-determined answers for the rising new needs from the uncertainty. According to Faraj and Sproull (2000), expertise coordination has three dimensions, knowing where expertise is located, recognizing where it is needed, and bringing it to bear. They are not rigid steps that must occur in a preset temporal progression. They represent general patterns of activity that a team needs to manage to be effective.

When participative culture is established in the team context, the ISDP team members are engaged in the processes of responding to changes. Participative culture generates a large pool of ideas from the individual members. The coordinative efforts of experts become efficient and effective. Therefore the following research model is proposed.
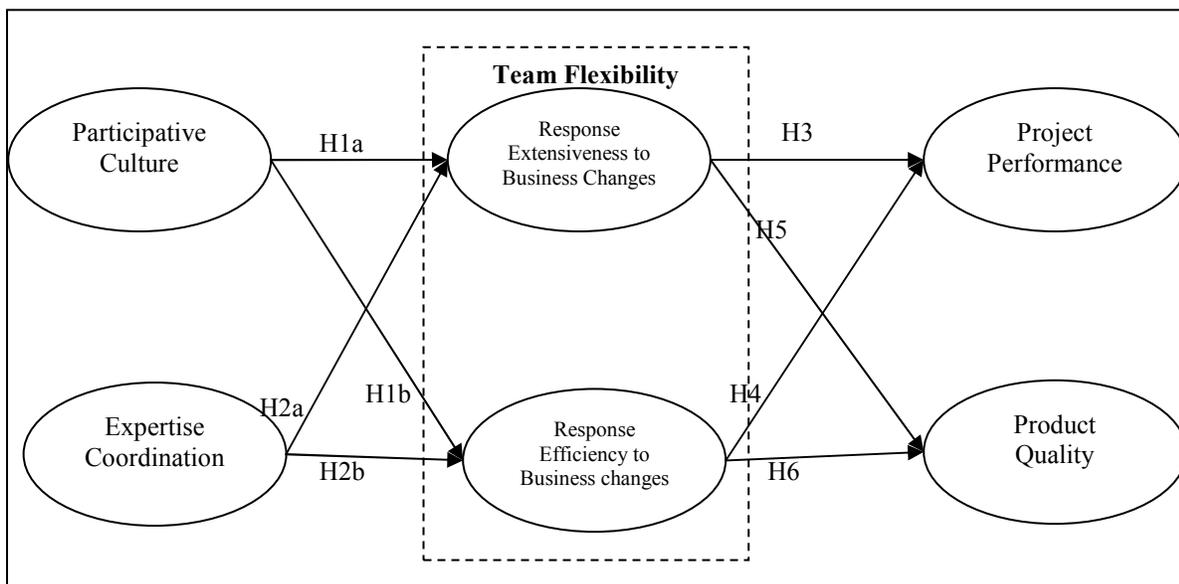

Figure 1 the proposed Research Model

HYPOTHESES DEVELOPMENT

Participation facilitates creativity in solving problems and enhances team learning in uncertain environments (Hulsheger et al., 2009). Participative culture encourages the team to sense and respond to the business changes

quickly. The interaction among related stakeholders and team members through participation increase the knowledge overlap and push the team to select the most feasible solution and respond to the changes effectively. The participative culture engages all the related stakeholders and encourages the commitment to changes. The response to changes can be implemented efficiently. Therefore,

H1a: Participative Culture will have a positive relationship with the ISDP team's Response Extensiveness to Business Changes.

H1b: Participative Culture will have a positive relationship with the ISDP team's Response Efficiency to Business Changes.

The business changes in software development process are usually non-routine challenges. The overlapping task knowledge and a map of the expertise locations enable the ISDP team to have a high level of absorptive capacity. With this absorptive capacity, the team can utilize the prior existing knowledge, assimilate the new information and apply on the problems effectively (Cohen & Levinthal, 1990). Expertise coordination happens in the processes that are distributed, heedful and emergent (Faraj & Sproull, 2000). Supportive and flexible joint action between the experts makes the development of responses to changes quickly and effectively. Because answers or solutions are not pre-specified, intensive interaction and discussion can generate feasible solutions and enable the resources to be pooled and used to implement the changes in a timely manner. Therefore we propose that

H2a: Expertise Coordination will have a positive relationship with the ISDP team's Response Extensiveness to Business Changes.

H2b: Expertise Coordination will have a positive relationship with the ISDP team's Response Efficiency to Business Changes.

Typical business changes that happen in many software development processes include changes in system delivery date and project budgets, changes in the functional requirements of the system being development and changes in non-functional or operational requirements such as system throughput, system response time and reliability, etc (Lee & Xia, 2005). The extensive response to business changes will make the final system to have the required functionalities, embed the organizational business rules/processes in the system and provide a user interface that future users feel comfortable with. Project budget and delivery time may be inconsistent with the project plan when the project set out. However, team flexibility makes it possible to achieve the effective changes with the minimum changes in budget and delivery time. Therefore we propose that

H3: Response Extensiveness to Business Changes will have a positive relationship with project performance.

The ISDP teams with flexibility have the capability to respond to business changes in an efficient way because of the team design and resource allocation at the early stage. The rich experiences and effective communication enable the highly skilled team members to know the key barriers of change process, develop the solutions with few mistakes, and utilize the available resources to a maximum extent (Verganti, 1997). The right estimation of change scope enables the project to be on time and under budget. In this way, the ISDP project team is competent in accomplishing the changes in the economic sense. Therefore, it is proposed that

H4: Response Efficiency to Business Changes will have a positive relationship with project performance.

ISDP teams with flexibility have a broad knowledge base. Team members with similar project experiences, domain experts and methodology experts are selected and recruited by project manager at the beginning of the project. The existing knowledge depository enables the team to respond extensively to system scope change and embed the business processes and rules in the system under development (Verganti, 1997). Domain experts with the rich business knowledge have the capability to understand the business rules and how the system reflects the business processes. The prior experience with similar project enables the team to anticipate user concerns and address them early in the development. New solutions can be generated effectively because of the high level team competence. Product quality will be high when the system reflects business processes and meet the user needs. Therefore we propose that

H5: Response Extensiveness to Business Changes will have a positive relationship with product quality.

The proactive thinking of possible changes prepares the ISDP teams with flexible solutions and good estimation of the change scope (Verganti, 1999). Therefore the ISDP teams have the capability to react to the changes in a larger scope or to a better extent. The flexible solutions are well embedded in the product system and operational efficiency of software system can be achieved. The system responsiveness meets the adjusted user expectations. It also reduces the possibility of software defects and bugs and leads to a high level of product quality. Therefore it is proposed that

H6: Response Efficiency to Business Changes will have a positive relationship with product quality.

RESEARCH METHOD

A survey design was selected to collect data and test the proposed model from previously published scales. The following provides details about variable definition, data collection procedures, and sample information.

4.1 Construct Measures

All research variables were measured using validated measurements. A 5-point Likert scale was used for all measures with anchors ranging from 1 (strongly disagree) to 5 (strongly agree). Participative culture includes the practices of encouraging team member participation and involving each individual in group meetings. Some agile practices including the daily standup meeting require everyone to report progress and plan for the work day. The measure has three items from (Eng 2005). A sample item is "Ideas from individual members are actively used in assisting project management." *The measure of expertise coordination* is adapted from Faraj and Sproull (2000) with five items. A sample item is "Team members know who on the team has specialized skills and knowledge that is relevant to their work." *ISDP flexibility* has two key dimensions: response extensiveness and response efficiency with items from a previous study (Lee & Xia, 2005). The measurement of ISDP team Response Extensiveness to Business Changes includes 6 items such as "To what extent did the project actually incorporate changes in system scope?" The measure of ISDP team Response Efficiency to Business Changes includes 6 items such as "How much additional effort was required to incorporate the changes in system input data?"*The measure of project Performance* comes from Nidumolu (1995) and describes how well the software development processes have been undertaken. It includes 5 items. One sample item is "To date, the projects finished on schedule." *Product quality* describes actual the system delivered to users and whether it conforms to the predefined requirements. The measure comes from Nidumolu (1995) and includes 5 items. One sample item is "The software is reliable".

4.2 Data collection

Target respondents of this study are members of information systems development project teams. The purpose of this study and the instruction in filling the survey were provided. The participant's project does not necessarily adopt any particular agile software development method. Almost all the ISDP teams try to be flexible and take several practices to address the flexibility issues. Each respondent fills in the survey and returns the completed survey to the contact person or return to the researcher directly.

Because all respondents were located in China, the survey was first translated in Chinese. The translation work was done by a researcher and validated by another researcher who is not involved in this study and fluent in both English and Chinese. The validated Chinese survey was then corroborated by a couple of experienced project managers. Some minor revisions were done before the survey was officially delivered. All items were measured on a 5 point Likert scale, with anchors ranging from 1 (strongly disagree) to 5 (strongly agree). The survey instrument was pilot tested and modified based upon the feedback.

The sample of this study is from an Alumni list of a prestigious Chinese University. This university in China has a high reputation in IT/MIS undergraduate education and its graduates are highly recruited by diversified industries. This group of IT practitioners are selected because they represent diversified industries that conduct IS development. A questionnaire package, including cover letter and questionnaire about coordination and project performance, was sent to the alumni who work in IT-related fields. Personal contacts and phone calls are made to encourage participations and introduction of other qualified participants. Follow-up calls and reminder emails were sent out two weeks later after the initial contacts.

To understand whether respondents actually reflect the population parameters, to exclude non-respondent bias, we compared the demographic data in this study with prior studies (Jiang, Klein, & Pick, 2003; Li, Jiang, & Klein, 2003). The result shows that respondent characteristics among these studies are similar. Because independent and dependent variables are from the same rater, common method variance might jeopardize the analysis result and additional inference (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Harman's single factor test was used to test the common method variance. The result indicated that more than one factor was extracted and total variance extracted is 74.58% and the first factor accounts for 32.80% of variance only. Since no one factor can represent all indicators, common method variance is not evident in this study.

DATA ANALYSIS

5.1 Demographic

In total, 179 teams formed the sampling pool showed their willingness to participate in this study. 129 teams returned the survey. Out of the received responses, questionnaires from ten teams were incomplete and thus were discarded from the sample. This results in a final data set of 119 observations. Table 1 shows the demographic statistics. Since all members form a team were invited, many roles were included in the study adding a broader perspective.

Variables	Categories	#	%	Variables	Categories	#	%
Gender	Male	85	71.4	**Average Project Duration**	< 1 year	47	39.5
	Female	31	26.1		1-2 years	40	33.6
	Missing	3	2.5		2-3 years	15	12.6
Position	Project Member	62	52.1		3-5 years	7	5.9
	System/business Analyst	3	2.5		>=6 years	1	0.8
	Project Leader	14	11.8		Missing	9	7.6
	IS Manager	12	10.1	**Industry**	IT Industry	66	55.5
	Program Manager	10	8.4		Non-IT Industry	44	36.9
	Client	1	0.8		Missing	9	7.6
	Product Director	1	0.8	**Company Size**	<=50	38	31.9
	Product Manager	6	5.0		50-500	58	48.7
	IT Director	3	2.5		500-1000	5	4.2
	Other	2	1.7		>1000	11	9.2
	Missing	5	4.2		Missing	7	5.9

Table 1. Demographic analysis

5.2 PLS analysis

Hypotheses were tested and verified by employing the method of Partial Least Squares (PLS) (Löhmoller, 1989). PLS is a latent structural equation modeling technique that uses a component-based approach to estimation and it contains two steps. The first step is to examine the measurement model and the second step is to assess the structural model. In addition, while using PLS to test the hypothesized model, researchers should pay attention to three major concerns: (1) the reliability and validity of measures; (2) the appropriate nature of the relationship between measures and constructs; and (3) path coefficient, model adequacy, and a final model from the available set of alternatives (Hulland, 1999). PLS-Graph version 3.00 was used in this study to test the hypotheses.

5.2.1 Measurement Model

Item reliability, convergent validity, and discriminant validity test are often used to test the measurement model in PLS. Individual item reliability can be examined by observing the factor loading of each item. High loadings imply that the shared variance between constructs and its measurement is higher than error variance (Hulland, 1999). Factor loadings higher than 0.7 can be viewed as having high reliability and factor loading less than 0.5 should be dropped.

Convergent validity should be assured when multiple indicators were used to measure one construct. It can be examined by reliability of questions (Cronbach's alpha), composite reliability of constructs, and variance extracted by constructs (AVE) (Fornell & Larcker, 1981). For the convergent validity, the variance extracted for each construct is larger than 0.5, and the item-construct correlation are all more than 0.7. All the above evidences show that the measurement has high convergent validity.

Discriminant validity focuses on testing whether the measures of constructs are different from each other (Messick, 1980). It can be assessed by testing whether the square root of AVE is larger than correlation coefficients (Chin, 1998; Fornell & Larcker, 1981). The discriminant validity is also assured because the square root of AVE is larger than the correlation between constructs. All indicators in this study have loading higher than 0.6, the minimum

composite reliability is 0.84 for instrumentality, and the item-total correlation are all higher than 0.3. The square root of the AVE shown in the diagonal of the Correlation Matrix in Table 2 exceeded the threshold of 0.70. As indicated in Table 2, the AVEs are greater than the inter-construct correlations. The results exhibit strong construct reliability and validity.

Variables	Mean	SD	M3	M4		Correlation Matrix					
						PC	EC	EXB	EFB	PP	PQ
Participative Culture (PC)	3.32	0.91	-0.04	-0.76		**0.88**					
Expertise Coordination (EC)	3.60	0.79	-0.33	-0.50		0.68	**0.79**				
Response Extensiveness to Business Changes (EXB)	3.69	0.66	-0.15	-0.20		0.32	0.33	**0.70**			
Response Efficiency to Business Changes (EFB)	3.38	0.80	-0.34	-0.23		0.34	0.41	0.58	**0.72**		
Project Performance (PP)	3.55	0.89	-0.49	-0.16		0.41	0.52	0.17	0.08	**0.84**	
Product Quality (PQ)	3.63	0.83	-0.75	0.50		0.49	0.57	0.32	0.27	0.70	**0.82**

Table 2. Descriptive Statistics

5.2.2 Structural Model

Basic information about each variable used in this study was listed in Table 2, including means, standard deviation, skewness, and kurtosis. Each examined variable's skewness value was less than 2 and kurtosis value was less than 5 indicated no significant violation of normal distribution (Ghiselli, Campbell, & Zedeck, 1981). Table 3 shows the path analysis result. Mediating effects showed in two different parts. The first part is from the independent variable to mediators and the second part is from mediators to dependent variable. The upper Table 3 indicates the first part and the test result shows that expertise coordination have positive and significant effects on ISDP team response extensiveness and response efficiency to business changes. Participative culture has a positive and significant effect on response extensiveness to business changes only. Response extensiveness has a positive and significant effect on product quality. Response efficiency has a positive and significant effect on both project performance and product quality. Therefore, all the proposed hypotheses were supported except H1b and H3 (See Figure 2).

Coefficient (S.E.)	Response Extensiveness to Business Changes (EXB)	Response Efficiency to Business Changes (EFB)	**Dependent Variables:** Project Performance (PP)	**Dependent Variables:** Product Quality (PQ)
Participative Culture (PC)	0.17 (0.13)*	0.13(0.14)	-	
Expertise Coordination (EC)	0.23(0.13)*	0.38(0.13) **	-	
Response Extensiveness to Business Changes (EXB)	-	-	0.14(0.13)	0.21 (0.10)**
Response Efficiency to Business Changes (EFB)	-	-	0.12(0.16)*	0.24 (0.10)**

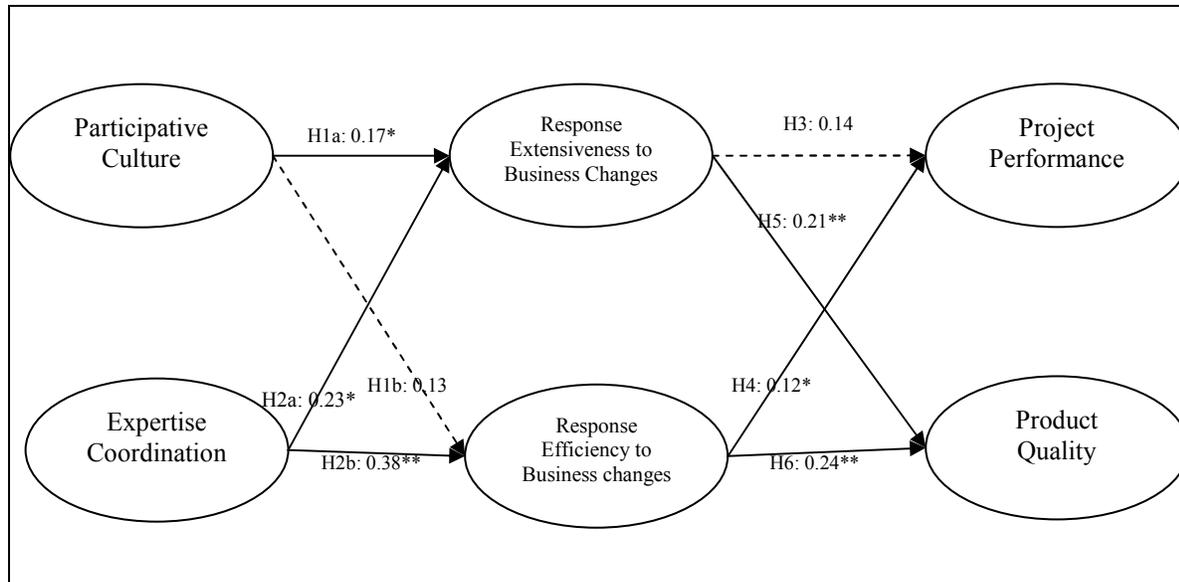**Table 3: Path analysis – Hypotheses testing results**

Figure 2 the Model Test Results

CONCLUSION AND DISCUSSION

The objective of this research was to examine two antecedents of ISDP team flexibility and the mediating role of team flexibility on project outcomes. The results of this study extend the current research on antecedents for ISDP team flexibility by examining the roles of participative culture and expertise coordination. Expertise coordination has been found to have significant and positive effects on the ISDP team flexibility to business changes while participative culture only has a significant and positive effect on response extensiveness to business change. The ISDP team flexibility has strong and significant effects on product quality but only the response efficiency to business changes matters to the project performance in a significant way.

The significance of participative culture for agile software development process is consistent with the need to engage users frequently. A participative culture can add weight to the emphasis on the importance of user participation as a critical success factor in software development. For example, user participation has been noted to an effective way to predict requirement changes (Hartwick & Barki, 1994; He & King, 2008). Participative culture could act as a substitute for control and reduce conflicts between users and developers or among multiple stakeholders and as collective inputs from stakeholders. The results suggested that integrating the antecedent variables of participative culture to explain ISDP team flexibility need to be considered in the future.

From an absorptive capacity perspective, participative culture sets up a supportive context for knowledge sharing and preparing a knowledge map for solution generation when the changes are identified. From the resource perspective, the participative culture engages the team and related stakeholders and gets them committed to changes in the process of solution development. The expertise coordination process is also a process of mobilizing the expertise resource and utilizing the resource in an effective and efficient way.

This study further contributes to the research on ISDP team flexibility. First, this study contributes to the software development flexibility literature by examining the antecedents of ISDP flexibility. By studying the effects of participative culture and expertise coordination, we examined the context in which ISDP team flexibility occurs. We noted that the participative context increases the ISDP team's response extensiveness to business changes but is not helpful in responding efficiently to business changes. Second, this research contributes to understand the mediating effect of team flexibility. ISDP teams develop the capability of being flexible to business changes when team members are encouraged to participate.

IT practitioners should consider adopting best practices of agile software development methodologies which have embedded participation and expertise coordination. In addition, some "best practices" from the agile software development methodologies such as Extreme Programming (XP) can be applied in general ISDP teams including close interaction between developers and users, rich feedback through formal and informal reviews, recruitment of highly skilled and motivated team members, and management support for abundant resources (Williams & Cockburn, 2003) (Cockburn, Highsmith, & Boehm, 2001; Highsmith, Cockburn, & Boehm, 2001).

As in any other study, this paper has several limitations. The limited sample size and national culture add limitations to the generalization of the study results. The survey methodology limits the understanding of the context in which each project takes place. This paper only examines two antecedents of ISDP team flexibility, participative culture and expertise coordination. Future research can consider identifying more antecedents of ISDP team flexibility.

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