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Organizational Capability and Process Innovation of Software Project in the Malaysian Public Sector

Rozaida Mohd Darus[1], Mahanum Daim[2]

Faculty of Industrial Management

Universiti Malaysia Pahang, 26300 Gambang, Pahang, Malaysia

Abstract: **This study used the partial least square (PLS) and structural equation modeling (SEM) tool to examine factors influencing the process innovation as the competitive advantage in organization. Statistical results confirm that coordination of expertise, communication plan, IT infrastructure flexible and IT infrastructure reach impact on process innovation in software project in the Malaysian public sector. Besides indicating the suitability of the PLS in statistical analysis, the result has also contributed to a better understanding the process innovation in an organization. Findings are useful for IT Managers and practitioners to achieve its competitive advantage through a well-planned organizational capability.**

Keywords: **Organizational capability, coordination of expertise, communication plan, IT infrastructure flexible; IT infrastructure reach; use of standard method and process innovation.**

1. INTRODUCTION

Fundamentally, a higher competitive advantage of an organisation should result in its higher performance gains [47]. According to Doing Business [19], published by the World Bank, Malaysia's position in terms of its competitiveness dropped from the 23rd in 2016 to the 24th in 2017 out of 190 economies. The organisational capabilities, which provide an organisation with the inputs required for its innovation, can contribute to its superior performance [21]. Therefore, innovation is perceived as a mechanism which can stimulate a drive within the public sectors towards delivering better quality public services and enhancing productivity. These steps are important for these sectors to manage the dynamic challenges of the global environment [10, 32]. This paper attempts to examine the competitive advantage of the software project from a multidisciplinary approach using quantitative technique within social science discipline which focuses on the social psychology of relationships incorporating elements of strategic management, business and technology.

Thus, Malaysia should redesign and restructure its public sector current systems and processes for a sustainable development and maintaining its competitive advantage [1]. Based on resource based view (RBV), assumes that a firm possesses or control a pool of resources and capabilities [42, 28] which are different in different organization, create competitive advantages which can improve a firm's performance [2]. According to Cohn. S [17], the implementation of innovation contribute for organization to achieve competitive which helps organization to minimize other issues related to cost and resources, create value, maintain competitive position in the market and sustain for long term prosperity. For example, in the manufacturing industry [11], information and technology [59, 48], small and medium enterprises (SMEs) [45], defence industry [9] and pharmaceutical [14, 58]. This shows that innovations can assist organizations to defend and strengthen their organizations in the market, besides as a source of competitive advantage [23, 12]. This paper attempts to examine the determinant of process innovation of organizational capability in the software project.

The next section of this paper discusses the research context and conceptual model in relation of existing literature on the organizational capability and relational construct such as coordination of expertise, communication plan, IT infrastructure flexible, IT infrastructure reach and the use of standard method in the organization. This is followed by an explanation of

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the research method used and assessment of goodness of measures, namely, the construct validity, convergent validity, discriminant validity and reliability of the constructs. Subsequent sections deal with data analysis, path analysis and hypotheses testing. The last section is on discussion and conclusion with suggestions for future research.

2. RESEARCH CONTEXT AND CONCEPTUAL MODEL

2.1. Organizational capability and process innovation

The notion of organizational capabilities has been developed within the resource-based view of the firm [6, 34]. Organizational capabilities are defined as an organization's capacity to deploy its assets, tangible or intangible, to perform a task or activity to improve the performance [40]. Barney [7] defines organizational capabilities as the firm attributes that enable organizations to coordinate and utilize their resources. Eisenhardt and Martin [21] define dynamic capabilities as "the firm processes that use resources to match and even create market change". The distinction between resources and capabilities is the source of the uniqueness of firms across the market. Although many researchers have used different terms, such as "combinative capabilities" [37], capabilities [2], "architectural competence" [31], and "dynamic capabilities" [21], the definitions for these terms all have to do with firm processes that use specific resources, integrate these resources together, reconfigure them and release new resources of competitive advantage [63].

In this research, the theoretical works of RBV [28], is suggested which attempts to conceptualize a comprehensive framework of relationships among resources, organizational capability and competitive advantage. According to Grant [28], the basic and primary inputs into organizational processes were tangible, intangible and human. Nonetheless, in organization, the resources are not as productive on their own. For the organization to create competitive advantage, individual resources must work together to initially establish. The literature also lends support fo the formulation of the research framework for examining the relationship betweeen coordination of expertise, communication plan, IT infrastructure flexible, IT infrastructure reach and the process innovation (see Fig. 1.)

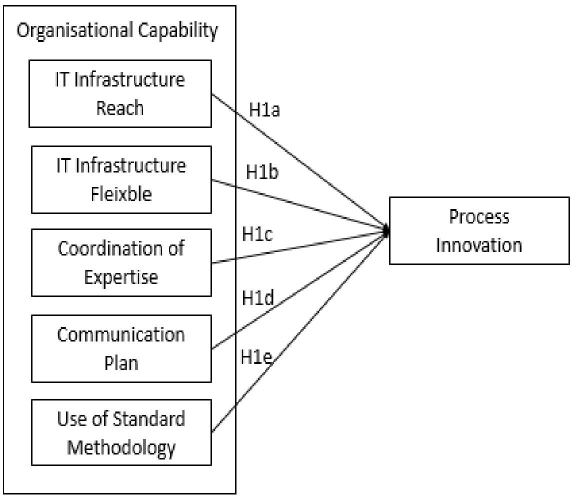

Fig. 1: Conceptual Model

2.2 Coordination of expertise

Coordination of expertise can be broadly defined as the level of the management on knowledge and skill dependencies [24]. This include knowing where a certain expertise is situated within a team, recognizing the needs for the expertise and bring it to a good use. As studies have indicated, organizations and teams need to coordinate their members' expertise in order to create value and achieve project objectives [61, 24]. Besides, experts bring their knowhow together (often expertise that is drawn from various disciplines and is based on years of experience) to innovate new concepts, products, and processes. In doing so, the integration of expertise attempts to address future needs (business transformation and innovation) rather than solving present problems (maintenance). In line with the literature on knowledge integration by Grant [27], the integration of expertise facilitates the organisation's ability to sense, interpret, and respond to new opportunities. This lead to the following hypothesis:

H1 *Coordination of expertise in organization has a direct positive effect on the process innovation.*

2.3 Communication plan

Project management Institute [46] defines it as the degree to which the information and communication needs of the stakeholders are determined. It is concerned with the decision of the target audience, time, message, and the methods as its guidelines. According to Fransson [26] cited in [13], designed a plan for a project group communication which may act as a tool to get the right stakeholders the right information at the right time. By planning in advance the risk of mistakes and irritation from stakeholders is decreased [62]. To plan for the future, communication processes can make resources more easily attained but also to decrease uncertainty from the customer of the project. It can also contribute to the result of the project and information of change progress is more easily distributed [39]. The communications plan should be linked directly to the overall strategic plan of an organization, to best inform the decisions of staff [33], promote change competence and innovation [49], and sharing of internal best practices coupled with better coordination of internal projects and processes [36]. Thus, the present study includes the following hypothesis:

H2 *Communication plan in organization has a direct positive effect on the process innovation.*

2.4 IT Infrastructure

Organizations are rapidly adopting new technologies in an attempt to gain competitive advantage [22]. According to the IT Infrastructure analysis grid [67], technical IT infrastructure capability can be operationalized into two dimensions which are functional efficiency and flexibility of components and this construct was adapted to suit the current context. Reach of IT Infrastructure refers to the extent to which technical IT capability meets a project's team basic need (ITREACH) while flexible of IT Infrastructure refers to refers to the extent to which the technical IT infrastructure capability satisfies a project's team changing needs caused by IT and project changes (ITFLEX). Banker and Kauffman [4] suggest that IT infrastructure development is one of the most critical issues to capture managerial implications of IT. Several studies have examined the macro-level impact of IT infrastructure capabilities on business process agility [59], competitive advantages [8, 15] and organization performance. For example, [38] found that IT infrastructure capabilities are positively related to business process improvement. Since IT infrastructure is considered one of the most important IT resources [41], its positive performance implication are expected. Thus, the present study propose the following hypotheses:

H4 *IT Infrastructure flexible in organization has a direct positive effect on the process innovation.*

H5 *IT Infrastructure reach in organization has a direct positive effect on the process innovation.*

2.5 Use of standard method

White and Fortune [66] define use of standard method as the level of a set of software development method, techniques, and tools which assists the practitioners in conducting their tasks and executing the processes taken in software projects. Lack of, or inappropriate use of a standard method has been considered to increase the risk of project failure [44, 55]. The selection of software development method and planning techniques do impact project results [64]. Furthermore, it has been found that using separate special purpose tools for different tasks can increase the organization's flexibility and responsiveness in changing business environment [53]. Thus, many companies rely on standards and product lifecycle management tools to guide the industrial processes [50]. As software projects are closely related with the IT infrastructure, software and hardware, once a project has been accepted, it is highly recommended to use a methodology and software tools for a structured approach to achieve the competitive advantage in an organization. Hence, the following hypothesis is formed:

H5 *Use of standard method in organization has a direct positive effect on the process innovation.*

3. RESEARCH METHOD

The unit of analysis in this study is IT Managers in Malaysia public sector. IT Managers were involved in software development projects. Based on the general rule, the minimum number of respondents or sample size is five-to-one ratio of the number of independent variables to be tested. However, Hair et al. [30] proposed that the acceptable ratio is ten-to-one. Non-probability purposive sampling was used in this study. Since we could not get a list of all the elements of the population, we used a non-probability sampling of purposive sampling whereby only IT Managers that handled the software development project were chosen.

3.1 Data collection

Two hundred and fifty self-administered questionnaires were used for gathering data from the respondents. A multiple method of data collection was employed, whereby some questionnaires were mailed to the respondents, some e-mailed and some were personally administrated. The process of distribution and collection of questionnaires was carried out over a period of 3 months. A total of 228 questionnaires were received and used for this analysis which translates to about a 91.2% response rate. The next section presents the assessment of the goodness of measure of theses constructs in terms of their validity and reliability within the research framework.

3.2 Measures and assessment of goodness of measures

A questionnaire using a seven-point Likert scale was used to gather data for each construct of the research model. All instruments were adapted from previous literatures and were modified to measure the success of the software project performance. Constructs have been operationalized in a multi item construct to ensure a comprehensive evaluation and at the same time avoid the drawbacks of using a single item measure [16]. The questionnaires were designed by adapting from previous studies namely [46, 29, 67, 24, 66].

3.3 Goodness of measures

The two main criteria used for testing goodness of measures are validity and reliability. Reliability is a test of how consistently a measuring instrument measures whatever concept is measuring, whereas validity is a test of how well an instrument that is developed measures the particular concept it is intended to measure [57].

3.4 Construct validity

Construct validity testifies on how well the results obtained from the use of the measure fit the theories around which the test is designed [57]. First, we looked at the respective loadings and cross loadings from TABLE 1 to access if there are problems with any particular items. We used a cut off value for loadings at 0.5 as significant [30]. As such, if any items which has a loading of higher than 0.5 on two or more factors then they will be deemed to be having significant cross loadings.

TABLE 1: Loading and cross loadings

	Coordination of Expertise	Comm Plan	ITI Flexible	ITI Reach	Proc Inno	Std Method
Co_Expertise1	**0.777**	0.438	0.408	0.386	0.381	0.377
Co_Expertise2	**0.878**	0.549	0.510	0.453	0.479	0.420
Co_Expertise3	**0.889**	0.517	0.521	0.458	0.490	0.450
Co_Expertise4	**0.859**	0.519	0.477	0.435	0.481	0.435
Co_Expertise5	**0.826**	0.473	0.478	0.414	0.447	0.454
Comm_Plan1	0.529	**0.867**	0.608	0.539	0.507	0.426
Comm_Plan2	0.509	**0.874**	0.567	0.536	0.538	0.385
Comm_Plan3	0.546	**0.894**	0.562	0.519	0.541	0.408
Comm_Plan4	0.482	**0.842**	0.559	0.462	0.482	0.413
Comm_Plan5	0.522	**0.903**	0.523	0.494	0.472	0.399
ITFlexible1	0.445	0.568	**0.885**	0.662	0.556	0.449
ITFlexible2	0.492	0.536	**0.919**	0.708	0.622	0.432
ITFlexible3	0.554	0.601	**0.867**	0.667	0.576	0.494
ITFlexible4	0.504	0.566	**0.879**	0.675	0.558	0.446
ITFlexible5	0.518	0.583	**0.869**	0.652	0.480	0.495
ITReach1	0.348	0.478	0.660	**0.871**	0.520	0.300
ITReach2	0.380	0.523	0.686	**0.908**	0.519	0.298
ITReach3	0.482	0.525	0.690	**0.909**	0.547	0.366
ITReach4	0.539	0.525	0.649	**0.832**	0.501	0.436
ITReach5	0.480	0.507	0.654	**0.860**	0.524	0.402
Process_Inno1	0.446	0.468	0.533	0.489	**0.832**	0.336
Process_Inno2	0.433	0.504	0.565	0.532	**0.872**	0.390
Process_Inno3	0.419	0.411	0.459	0.421	**0.789**	0.323
Process_Inno4	0.502	0.579	0.564	0.526	**0.876**	0.333
Process_Inno5	0.477	0.479	0.550	0.539	**0.848**	0.284
Std_Method1	0.426	0.387	0.437	0.316	0.346	**0.924**
Std_Method2	0.401	0.480	0.436	0.416	0.371	**0.816**
Std_Method3	0.426	0.387	0.437	0.316	0.346	**0.924**
Std_Method4	0.464	0.376	0.475	0.354	0.342	**0.850**
Std_Method5	0.473	0.359	0.474	0.371	0.285	**0.795**

Bold values are loadings for items which are above the recommended value of 0.5

3.5 Convergent validity

The convergent validity is the degree to which multiple items to measure the same concept are in agreement. As suggested by Hair et al. [30], we used the factor loadings, composite reliability and average variance extracted to assess convergence validity. The loadings for all items exceeded the recommended value of 0.5. Composite reliability values (see TABLE 2), which depict the degree to which the construct indicate the latent, construct range from 0.925 to 0.947 which exceeded the recommended value of 0.7. The average variance extracted (AVE) measures the variance captured by the indicators relative to measurement error, and it should be greater than 0.50 to justify using a construct [5]. The average variance extracted, were in the range of 0.712 to 0.781.

3.6 Discriminant validity

The discriminant validity of the measures (the degree to which items differentiate among constructs or measure distinct concepts) was assessed by examining the correlations between the measures of potentially overlapping constructs. Items should load more strongly on their own constructs in the model, and the average variance shared between each construct and its measures should be greater than the variance shared between the construct and other constructs [18]. As shown in TABLE 3, the squared correlations for each construct are less than the average extracted by the indicators measuring that construct indicating adequate discriminant validity. In total, the measurement model demonstrated adequate convergent validity and discriminant validity.

TABLE 2: Composite Reliability

Model Construct	Measurement Items	Loading	CR [a]	AVE [b]
Coordination of Expertise	Co_Expertise1	0.777	0.927	0.717
	Co_Expertise2	0.878		
	Co_Expertise3	0.889		
	Co_Expertise4	0.859		
	Co_Expertise5	0.826		
Communication Plan	Comm_Plan1	0.867	0.943	0.768
	Comm_Plan2	0.874		
	Comm_Plan3	0.894		
	Comm_Plan4	0.842		
	Comm_Plan5	0.903		
IT Infrastructure Flexible	ITFlexible1	0.885	0.947	0.781
	ITFlexible2	0.919		
	ITFlexible3	0.867		
	ITFlexible4	0.879		
	ITFlexible5	0.869		
IT Infrastructure Reach	ITReach1	0.871	0.943	0.768
	ITReach2	0.908		
	ITReach3	0.909		
	ITReach4	0.832		
	ITReach5	0.860		
Process Innovation	Process_Inno1	0.832	0.925	0.712
	Process_Inno2	0.872		
	Process_Inno3	0.789		
	Process_Inno4	0.876		
	Process_Inno5	0.848		
Use of Standard Method	Std_Method1	0.924	0.936	0.746
	Std_Method2	0.816		
	Std_Method3	0.924		
	Std_Method4	0.850		
	Std_Method5	0.795		

[a] Composite reliability (CR) = (square of the summation of the factor loadings)/{(square of the summation of the factor loadings) + (square of the summation of the error variances)} [b]Average variance extracted (AVE) = (summation of the square of the factor loadings)/{(summation of the square of the factor loadings) + (summation of the error variances)}

TABLE 3: Discriminant validity of construct

Constructs	**1**	**2**	**3**	**4**	**5**	**6**
Coordination of Expertise	**0.847**					
Communication Plan	0.591	**0.876**				
IT Infrastructure Flexible	0.568	0.644	**0.884**			
IT Infrastructure Reach	0.508	0.584	0.762	**0.876**		
Process Innovation	0.541	0.582	0.635	0.596	**0.844**	
Use Standard Methodogy Method	0.505	0.463	0.522	0.411	0.394	**0.864**

Diagonals (in bold) represent the average variance extracted while the other entries represent the squared correlations

3.7 Reliability analysis

We used the Cronbach's alpha coefficient to assess the inter item consistency of our measurement items. TABLE 4 summarizes the loadings and alpha values. As seen from Table 4, all alpha values are above 0.6 as suggested [43]. The composite reliability values also ranged from 0.901 to 0.946. Interpreted like a Cronbach's alpha for internal consistency reliability estimate, a composite reliability of 0.70 or greater is considered acceptable [25]. As such we can conclude that the measurement are reliable.

Due to the self-reported nature of the data, there was a potential for common method variance, and so the Harman one-factor test was conducted to determine the extent of this. According to Podsakoff and Organ [47], common method bias is problematic if a single latent factor would account for the majority of the explained variance. The un-rotated factor analysis is showed that the first factor accounted for only 45% variance explained by a single factor shows that the common method bias is not a major concern in this study (less than 50% cut-off point). The result is obtained by running un-rotated, a single factor constraint of factor analysis in SPSS statistic.

TABLE 4: Result of reliability test

Construct	Measurement Items	Cronbach's α	Loading range	No of Items
Coordination of Expertise	Co_Expertise1, Co_Expertise2, Co_Expertise3, Co_Expertise4, Co_Expertise5	0.901	0.777-0.826	5
Communication Plan	Comm_Plan1, Comm_Plan2, Comm_Plan3, Comm_Plan4, Comm_Plan5	0.924	0.842-0.903	5
IT Infrastructure Flexible	ITIFlexible1, ITIFlexible2, ITIFlexible3, ITIFlexible4, ITIFlexible4	0.930	0.867-0.919	5
IT Infrastructure Reach	ITIReach1, ITIReach2, ITIReach3, ITIReach4, ITIReach5	0.924	0.832-0.909	5
Process Innovation	Process_Inno1, Process_Inno2, Process_Inno3, Process_Inno4, Process_Inno5	0.899	0.789-0.832	5
Use Standard Method	Std_Method1, Std_Method2, Std_Method3, Std_Method4, Std_Method5	0.914	0.795-0.924	5

3.8 Hypotheses testing

Next, we proceeded with the path analysis to test the five hypotheses generated. Fig. 2 and TABLE 5 present the result. The R^2 value was 0.491 suggesting that 49% of the variance in extent of process innovation can be explained by coordination of expertise, communication plan, IT infrastructure flexible, and IT infrastructure reach and the use of standard method. A close look shows coordination of expertise was positively related ($\beta = 0.180$, $p < 0.01$), communication plan was positively related ($\beta = 0.196$, $p < 0.01$) to extent of process innovation, and so were IT infrastructure flexible ($\beta = 0.262$, $p < 0.01$) and IT infrastructure reach ($\beta = 0.192$, $p < 0.01$) whereas use of standard method was not a significant predictor of extent of process innovation. Thus, H1, H2, H3 and H4 of this study were supported whereas H5 was not.

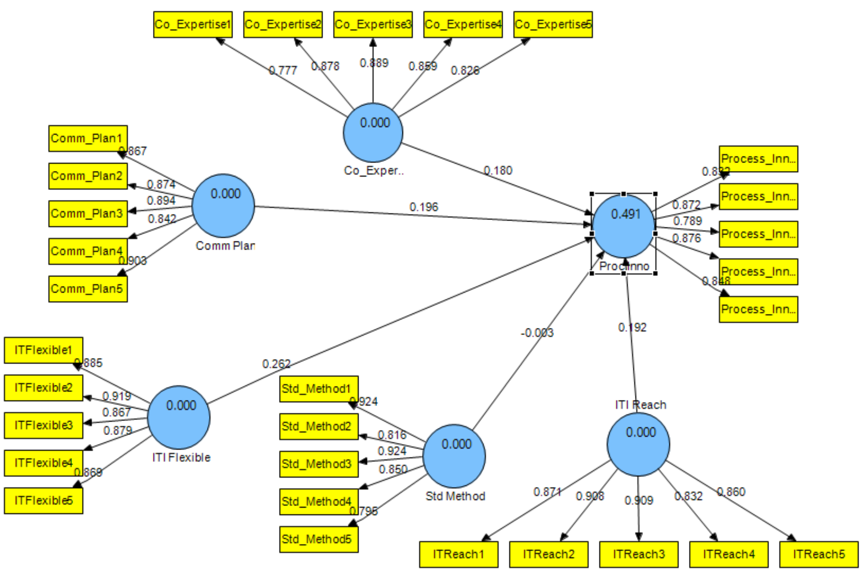

Fig. 2: Path coefficient hypothesis testing

TABLE 5: Path coefficient hypothesis testing

Hypothesis	Relationship	Coefficient	t-value	Result
H1	Coordination of Expertise -> Process Innovation	0.180	2.569	Supported
H2	Communication Plan -> Process Innovation	0.196	2.591	Supported
H3	IT Infrastructure Flexible -> Process Innovation	0.262	2.463	Supported
H4	IT Infrastructure Reach -> Process Innovation	0.192	1.968	Supported
H5	Use Standard Method -> Process Innovation	-0.083	0.057	Not Supported

4. DISCUSSION AND CONCLUSION

The finding of this paper confirmed views that coordination of expertise, communication plan, IT infrastructure flexible and IT infrastructure reach impact on process innovation with IT infrastructure flexible having the strongest impact in the organization. This corroborates with viewed from the RBV perspective, organizations are rapidly adopting new technologies in an attempt to gain competitive advantage [22]. IT infrastructure provides the resources that make feasible innovation and continuous improvement of products [20]. IT infrastructure flexible and IT infrastructure reach can improve the efficiency of operational process through automation, or enhance their effectiveness and reliability by linking them together. In an organization, coordination of expertise too has an influence on the process innovation in software project process which leads to higher levels of productivity, satisfaction with the process, and the product [3], [35]. By bringing all the experts together, it will affect the process innovation in the organization to become more competitive in order to innovate new concepts, product and process. Furthermore, by using more frequently and more effectively of formal project communication plans, allowing organization to successfully operate in a complex and competitive climate. This is aligned with previous studies where communications plan should be linked directly to the overall strategic plan of an organization, to best inform the decisions of staff [33], promote change competence and innovation [52] and also sharing of internal best practices coupled with better coordination of internal projects and processes [36].

On the other hand, the relationship between use of standard method and process innovation did not receive statistical support. In practise, applying techniques in software projects is not very systematic. White and Fortune [66] studied the application of project management techniques and found that project management software is frequently used in projects. In this study, the project lifecycle and management structure is different in each organization and therefore a project management methodology is not suitable for all cause whereby according to Seda Cansiz & Fatma Pakdil [56], major factors that have made a difference in the business world are the speed, flexibility and innovation. Therefore, by choosing the inappropriate methodology in organizational structure will not achieve the promised benefits as the standard method needs change constantly according to the current demand and need access to information on-line.

By using the PLS approach, statistical analysis of the data confirms generally accepted views that coordination of expertise, communication plan, IT infrastructure flexible, and IT infrastructure reach influence process innovation in software organization. The organisational capability, which provide an organisation with the inputs required for its innovation, can contribute to its superior performance [21]. Therefore, innovation is perceived as a mechanism which can stimulate a drive within the public sectors towards delivering better quality public services and enhancing productivity. These steps are important for these sectors to manage the dynamic challenges of the global environment [10, 32].

This paper has its limitations in regards to quantifying and measuring a software project from various stakeholders that involved in the project. Our study is directed to the IT Manager who is responsible for the daily software project that believed to cause some biases. Therefore, for future study it is possible to have different types of respondents from the perspective of several stakeholders, including customers, users and developers to answer different part of the questionnaires according to their own personality, mentality and set of problem solving skills, to particular tasks(s) associated with the software projects.

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