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HOW OPERATIONAL CAPABILITIES MEDIATE THE RELATIONSHIP BETWEEN ENVIRONMENTAL PRESSURES AND INFORMATION TECHNOLOGY PROJECT PERFORMANCE

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ABSTRACT

The purpose of our study is to determine if operational capabilities mediate the relationship between environmental pressures and information technology (IT) project performance for US and Chinese project managers. Specifically, we examine operational capabilities pertaining to process maturity level, technical knowledge, project manager competency, and financial resources as they relate to environmental (i.e., competitive and regulatory) pressures. Our results suggest operational capabilities mediate the relationship between environmental pressures and IT project performance. These findings may aid firms to make better operational decisions and in turn to achieve better project performance by fully capitalizing their operational capabilities.

Keywords: information technology, IT project planning, IT project performance, empirical research, comparative study

INTRODUCTION

Project management in organizations has grown considerably over the last few years. Yet even with the leadership of supporting organizations like the Project Management Institute, the majority of projects still fail [81]. Project failure rate is also high among IT projects according to Hayes [35]. Standish Group Survey [75] found the overall project failure rate to be over 70 percent in the US. The high failure rates of projects have lead researchers to explore and identify potential determinants leading to project success or failure. Many of these studies have been conducted in the US or other Western culture countries. Many of the studies also utilize a set of particular domain factors in countries with distinctive cultures (e.g., [70]). Schmidt et al. [70] conducted an assessment of multiple risk factors of software project management with a panel of experts from three different countries (i.e., wqUS, Hong Kong and Finland). The results of the study provided general guidelines for project teams when conducting software projects. Haried and Ramaurthy [33] found similar results in differing countries with IT outsourcing projects.

In addition to the outcome of project performance, other factors leading to project success include environmental pressures (e.g., regulatory pressure), operational capabilities (e.g., project manager competency), and how they are aligned to achieve project success. While alignment has been frequently studied (e.g., [12, 11, 43, 71]) little research exists about how operational capabilities affect the relationship between environmental pressures and organizational performance. One key question is how operational capabilities should be included in research models. Another question is whether operational capabilities serve as mediating or moderating variables. Neither of these relationships has been thoroughly addressed in the literature. The way in which constructs are incorporated into research models has important theoretical and practical implications, which we will explore. In this study we build on prior IT and operations management research that has examined alignment [12, 11, 30, 43, 71] by investigating whether operational capabilities mediate the relationship between environmental pressures and information technology (IT) project performance. Specifically, the current study examines operational capabilities pertaining to process maturity level (i.e., the degree of formality and optimization in the processes of a business), technical knowledge, project manager competency, and financial resources as they relate to environmental (i.e., competitive and regulatory) pressures. The model tested in the current study is shown in Figure 1.

Literature regarding the relationship between environmental pressures and project performance; and the relationship between operational capabilities and project performance is reviewed below. Hypotheses pertaining to the mediating effects of operational capabilities on the relationship between environmental pressures and project performance are then developed.

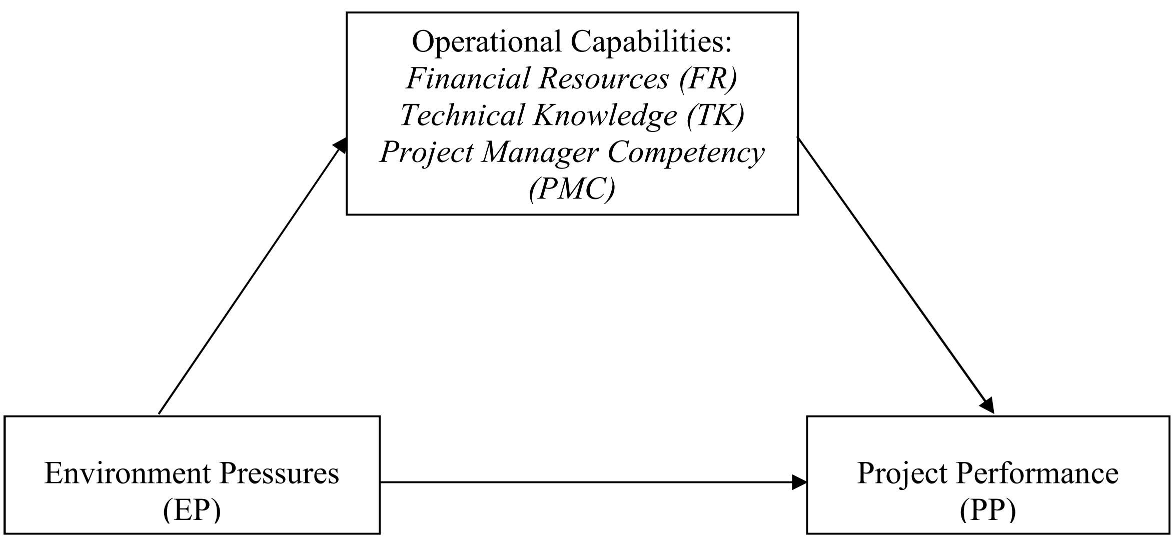

Figure 1: Research Model (Mediation)

THEORETICAL FRAMEWORK

The Effect of Environmental Pressures on IT Project Performance

There is a considerable body of research that suggests a firm's external environment is theoretically and empirically linked to performance [41, 55, 61, 66, 68, 80]. The external environment can include an industry context, a macroeconomic context, and other national and cultural factors [13]. Organization theorists generally agree organizations with greater power over their environments are better able to function and survive than their less powerful counterparts [78].

Extant research has identified the influencing role of the environment on project performance. Ling et al. [53] found that implementing project management practices originated from one country can result in different project performance outcomes due to a different operating environment in a different country. Also, environment factors such as competitive pressure was found to radically alter user requirements and render entire project obsolete in software development [70].

In addition to competitive pressure, government regulatory pressure is also found to influence business operations and their projects [4]. Extending the study by Badri et al. [4], Darnall [19] found regulatory pressure could constrain an organization's financial opportunities impacting projects like the "greening" of organization. In addition, other regulations were found to spur product and technology innovations, as well as encourage greater operational efficiencies.

The Effect of Operational Capabilities on IT Project Performance

While a great deal of research on project performance has focused on the project manager's individual leadership [81, 1], one organizational factor that has also received attention is the impact of operational capabilities on project performance [70]. The idea that operational capabilities can affect organizational performance, including project performance, is supported by the resource-based view (RBV) of the firm [5]. RBV states a firm's resources are part of the firm's capability attributes that support business strategy and operational activities. This theory of the firm is of interest to researchers since it was first presented early in 1959 [65]. Penrose [65] argued that a firm is a collection of productive resources and also an administrative decision making unit controlling the allocation of those productive resources. Most scholars consider Barney's resource theory as the modern RBV of the firm [5]. Barney [5] suggests there can be heterogeneity or firm-level differences allowing creative competitive advantages. When the advantages are afforded by the resources, which are difficult for competitors to imitate or purchase, superior performance becomes sustainable. Based on RBV a firm's resources should include all assets, whether tangible or intangible, and include organizational processes, knowledge, firm attributes, information, and a positive culture. These resources are controlled by the firm and enable the firm to conceive and implement strategies that improve efficiency and effectiveness [5].

Recent studies also support the notion that operational capabilities can affect organizational performance within the context of the resource-based view (RBV) [52, 54]. It is indicated that operational capabilities act as mediating variables in how green supply chain management [52] or information technology [54] affects performance variables.

In the current study we focus on a limited number of resources/operational capabilities, specifically financial resources, process maturity, project manager competency, and technical knowledge. It should be noted that in this study we view technical knowledge as being related to project members' knowledge of methodologies, and project manager competency as being related to understand the firm's business model and his/her people management skills. What follows in the sections below is a review of literature establishing the link between each of these operational capabilities and project performance. Hypotheses regarding how each of these operational capabilities mediates the relationship between environmental pressures and project performance are then developed and put forth.

Financial resources and IT project performance

The resource-based view (RBV) of the firm indicates a firm's financial assets contribute tangibly to performance. As previously stated, a firm's financial resources are part of its capability attributes supporting business strategy and operations activities. While project management literature has not focused attention on investigating whether a firm's financial resources are critical toward project performance, Schmidt et al. [70] points out that funding, related to project development and product maintenance, is a risk factor for project performance. In another study Garcia-Merino et al. [26] found that intangible financial assets, such as information technology lead to investment project success. Based on this research we theorize financial resources have a positive effect on IT project performance.

Process maturity level and IT project performance

The body of project management literature regarding the relationship between an organization's project management process maturity level and project performance is substantial [45, 56]. One of the original models pertaining to process maturity level is the Capability Maturity Model (CMM) [39]. Humphrey [39] states the process capability maturity of an organization can affect technology change. Humphrey [39] reported that the change could be in software development or areas such as software engineering, system engineering, project management, software maintenance, business processes and/or risk management.

The stage maturity model proposed by Nolan [58] and the Software Engineering Institute (SEI) [73] stipulates five process maturity levels defined along the continuum of CMM. This model suggests control of an organization's software processes are improved as the organization moves up the five levels. The empirical evidence to date supports this belief in the SEI [20, 27]. While these models adopt the framework and structure established by CMM with five levels there is little research or conclusive findings regarding the degree to which maturity models actually support improvement in project or organizational results [56].

Although it can be argued that maturity models have helped elevate the discussion of project management and its contribution to organizational success, there is still limited empirical information currently available to support their use. For example, one study of the relationship between maturity and organizational results demonstrated no statistically significant correlation between process maturity and project performance [49]. A study by Yazici [81] found that CMM is significantly related to business performance, but not to project performance.

There appears to be a lack of consensus in the current literature. To extend the understanding of the role of process maturity on the relationship between environmental pressures and project performance, we examine the potential mediating effects of levels of CMM that provide relevance for IT project organizations. We chose CMM for our study, because it is currently recognized and widely accepted in process maturity models. We theorize that higher organizational process maturity level has a positive effect on IT project performance.

Technical knowledge, project manager competency, and IT project performance

Under the resource-based view (RBV) of the firm knowledge is viewed as a type of resource [28]. Santos et al. [69] empirically showed that knowledge acquisition and sharing leads to successful complex technology projects and that barriers to knowledge sharing can lead to less than desirable outcomes.

In this study we view technical knowledge as being related to project members' knowledge of methodologies, and project manager competency as being related to the degree of understanding of the firm's business model and his/her people management skills. The importance of technical and business skills has been advocated in the IS literature for decades. For example, Harris [34] mapped out the need for chief information officers (CIOs) to have IS and IT business knowledge and skills in order to be effective leaders. The implication from the study was that technical and business skills are related to business success.

Risk factors associated with IT software project performance where a person's lack of knowledge, including technical and business knowledge, was ranked highly on a risk factor listing [70]. Chinowsky et al. [35] and Doloi [21] found both technical and managerial knowledge about people skills, risk management and business skills were all positively related to project performance. Studies by Lee and Mirchandani [51] and Stemberger et al. [76] found technical and managerial knowledge were positively related to planning in IT project performance. Based on these research findings we theorize that technical knowledge of project team members has a positive effect on IT project performance and that project manager competency has a positive effect on IT project performance.

HYPOTHESIS DEVELOPMENT

Alignment

The concept of alignment was originally developed from the idea that businesses should align their resources to the competitive environment in which the business is situated [22, 79]. Early research on this topic by Ansoff [3] and Andrews [2] highlighted the importance of aligning business strategy with internal organization strengths and the external environment.

The Effect of the Alignment between Environmental Pressures and Operational Capabilities on IT Project Performance

Several prior research efforts have also suggested environmental factors may interact with operational capabilities in a manner that affects project performance. Barua et al. [6] found that project processes needed to be modified to meet changes in a business environment or if left unchanged, the organization would not perform as well in a volatile competitive environment. In addition, Clark [17] observed in a case study that competitive pressure required changes in project processes in order to improve the performance of contracted project services and that competitive pressure modifies the performance outcomes of projects. Thamhain [77] in a field study of technology-based project teams found the environment in which the project team operates can influence team performance. In a survey Hong and Schniederjans [37] empirically demonstrated the impact that global competitive pressure can have on new project development performance. They also found other factors, such as the size of the project is less important than factors such as balancing technology and human resources. Even the US governmental organizations like the US Navy have found their own regulations for IT projects impacting their end results and risk of project failure without proper alignment with broader operational structures [48]. More recently, Gupta et al. [32] found competitive pressure can be an enabler of IT in organizations. Their study found a positive relationship between competitive pressure and business performance.

How Operational Capabilities Mediate the Relationship between Environmental Pressures and IT Project Performance

Our study explores the possibility of a mediating role for operational capabilities in that it explains why there is a relationship between environmental pressures and project performance. A variable is considered to function as a mediator when it accounts for the relation between the predictor and the criterion. Under this premise in the case of mediation, when the effects of operational capabilities are removed, the relationship between environmental pressures and project performance would expect to disappear. Based on the literature an argument can be made that operational capabilities are mediating variables explaining why there exists a relationship between environmental pressures and IT project performance. Although prior studies have indicated the environment does directly affect firm level performance, we theorize that the environmental pressures affects operational capabilities, which in turn affect IT project performance. Specifically, we theorize that when the effects of operational capabilities are removed, the relation between environmental pressures and IT project performance will disappear. Hence, in summary, we test the following hypotheses in this study:

H1: A firm's financial resources mediate the relationship between environmental pressures and IT project performance (i.e., as financial resources increase, the relationship between environmental pressures and IT project performance becomes more positive).

H2: A project team members' technical knowledge mediates the relationship between environmental pressures and IT project performance (i.e., as technical knowledge increases, the relationship between environmental pressures and IT project performance becomes more positive).

H3: A project manager's competency mediates the relationship between environmental pressures and IT project performance (i.e., as project manager's competency increases, the relationship between environmental pressures and IT project performance becomes more positive).

H4: An organization's project process maturity level mediates the relationship between environmental pressures and IT project performance (i.e., as process maturity level increases, the relationship between environmental pressures and IT project performance becomes more positive).

METHODS

Sample

Data were collected from China and the United States due to their distinctive characteristics related to culture, capabilities and environment. In this study, we use firm as the unit of analysis, and as such various project professionals within firms were surveyed, and they were project managers, program executives, project coordinators, systems analysts, IT managers, and project consultants. Because our respondents were project professionals who were directly involved in the projects within the context of these firms, thus we believe their personal views on the dynamics of the projects as well as their professional conduct on carrying out the projects and managing related people (both the people within the project group as well as the firm's executives who oversee the project) have important impact on the project group and make a difference in the progress of the project. It is evident that a project professional's role is very critical in the ultimate outcome of project performance.

It is important to note that this study does not focus on merely project-based organizations but business organizations that utilize project management processes.

The primary reason for this is that project-based organizations (such as consulting firms) can only provide a much less complex working environment for researchers to access the project management performance while regular organizations (non-project-based) actually provide a more inter-twined and ideal research condition for us to access the impact of these different variables on project management. The essence of this research is to be able to access the overall impact of complex organizational variables on project performance. Thus the link between operations of any non-project-based organizations and "IT works" under project management approach is actually inter-related, and the management of one cannot be separated from the other.

For the Chinese survey a random sample of firms were chosen in five different industries: retail trade; information; finance and insurance; professional scientific and technical services; health care and social assistance based on the International Standard Industrial Classification (ISIC) codes. For the US survey random sample of firms was also selected in these five industries from the 2007 North American Industry Classification System (NAICS) Manual [59].

A total of 1,000 questionnaires were distributed in a single mailing in both China and US. Out of 285 responses in China 261 were usable, resulting in an actual response rate of 26.1%. The unusable surveys were ones that did not contain sufficient data for further analysis. Out of 198 responses in the U.S. 172 were usable, resulting in an actual response rate of 17.2%. These response rates are not unusual when the unit of analysis is the firm, and the questionnaire involves extensive organizational level questions [29].

In order to test for possible non-response bias, the companies that responded were compared with non-responding companies. Comparison of the distributions of the number of employees and the sales volumes showed no statistically significant differences at the $p < 0.1$ level [24].

Variables and Measurement

An argument can be made that organizations are systems made up of several moving parts that function at different levels of the organization. Even though these parts function at different levels of the organization they are still very intertwined. Because of this, looking at only how the parts of the system at the same level in the organization interact does not provide a complete picture of how the organizational system functions as a whole [30]. Thus, the current study examines how multi-level parts of the system interact with each other to affect performance at different levels of the organization (i.e., in current study we examine performance at the project level by examining how organizational level parts of the organizational system affect project level performance). This approach is consistent with prior research which found that environmental factors have direct and indirect links to both project level success and organizational level success, thereby connecting these two levels in the organization [7, 18].

In the current study, we went through questionnaire construction, pilot study and survey stages to increase the reliability and validity of the research. We constructed a questionnaire in the first stage of the research design. This process involves three steps: examining previous literature, developing the theoretical framework (as aforementioned) and constructing the questionnaire. Our research model included three constructs: environmental pressures, project capabilities, and IT project performance. The measurement of these constructs is discussed next.

Based on prior literature [16, 54, 63] the environmental pressures construct was measured by including questions on the survey pertaining to both regulatory and competitive pressures. The Operational capabilities construct consisted of four dimensions: financial resources, project manager competency, technical knowledge and process maturity level. The items for the financial resources dimension were adapted from a study of RFID implementation [50]. The items for the technical knowledge dimension were adapted from those used in a study of e-commerce adoption [72]. The measurement of the project manager competency dimension was adapted from prior research [46]. The items for the process maturity dimension were based on those used in previous CMM research [81].

The project performance (i.e., the dependent variable) items were adopted from Nidumolu [57] and they are benefits of projects to the organization are high; projects met budget requirements; projects helped the organization improve its competitive position; projects met expectations; project team members are satisfied to work together; projects resulted in sales growth; and projects helped the organization to increase market share. However, not all of the Nidumolu [57] items or dimensions were selected for this study as some of items are not relevant to our study. Items selected from Nidumolu [57] covered several dimensions from his study and were subsequently grouped into a uni-dimensional variable for this study. The items selected used to measure project performance are also found in other project management studies, such as Patanakul et al. [62], and Jha and Iyer [40].

In addition to the variables above, firm size industry, and country effects were controlled in the current study using dummy variables [31].

In summary, all items used to measure the constructs were adapted from previous studies and measured using a seven-point Likert Scale, except for project maturity where a five-point Likert Scale was used. A total of 31 items were used to measure the constructs in our model (see Table 1).

Once we constructed the preliminary questionnaire, interviews with key project professionals were then conducted. Next, several revisions pertaining to the key variables in the questionnaire were made. A pilot study was then conducted by distributing the revised preliminary questionnaire to project professionals of several companies in a Midwestern city located in the United States. The project professionals were asked to examine the degree to which the preliminary questionnaire captured the measured constructs and how easy or difficult the preliminary questionnaire was to complete. Based on feedbacks received in this pilot study minor adjustments were again made in the instrument before conducting the formal survey.

Instrument Validation

In this study overall instrument validity was assessed by evaluating the results of reliability, content, convergent, criterion-related, and construct validities [9].

According to Chau [14], Cronbach's alpha is the most widely used method of reliability assessment in business research. To assess reliability in the current study, we calculated Cronbach's alphas for all constructs and dimensions in our conceptual model [25]. It is based on the correlations among the indicators that include a measure with higher correlations among the indicators associated with high alpha coefficients [64]. The Cronbach's alpha values for the survey exceeded the suggested value of 0.70 (as shown in Table 2) generally considered adequate for assessing reliability in empirical research [60]. Thus, the scale items used in this research can be considered reliable.

In the current study, content validity was assessed through aforementioned pilot study and literature review. For criterion-related validity, the expected cross validity index (ECVI) was used in this research and ECVI values of all constructs were well below the value of 1 which deemed as adequate [47].

Confirmatory factor analysis (CFA) was employed to test uni-dimensionality of the constructs. Table 2 shows that standardized loadings for scale items ranged from 0.72 to 0.88 which indicate moderate-to-high ranges while t-values for scale items ranged from 8.54 to 18.31, exceeding the 2.0 rule-of-thumb. As such we conclude that all loadings for scale items were significant ($p < 0.01$).

Table 1: Items for Variables

Please indicate the degree to which you agree or disagree with the following statements. (Please circle the appropriate number from 1 to 7. Here 1 signifies "Strongly Disagree" and 7 signifies "Strongly Agree")	
Competitive pressure	
Com1 – The competition among firms is intense.	1 2 3 4 5 6 7
Com2 – The frequency of cost-increase in your industry is high.	1 2 3 4 5 6 7
Com3 – The demand for service of your customers is high.	1 2 3 4 5 6 7
Com4 – The degree of loyalty of your customers is low.	1 2 3 4 5 6 7
Regulatory Pressure	
Reg1 – The government regulation is strong.	1 2 3 4 5 6 7
Reg2 – The frequency of the regulatory changes in your industry is high.	1 2 3 4 5 6 7
Competent project managers	
Cpm1 – Project management has good understanding of technology.	1 2 3 4 5 6 7
Cpm2 – Project management has people skills and understands the business model.	1 2 3 4 5 6 7
Cpm3 – Effective project management can foresee problem and are good motivators and team leaders.	1 2 3 4 5 6 7
Process Maturity Levels of Maturity [1. Initial (chaotic, ad hoc, individual heroics) - the starting point for use of a new process; 2. Managed - the process is managed in accordance with agreed metrics; 3. Defined - the process is defined/confirmed as a standard business process, and decomposed to levels 0, 1 and 2 (the latter being Work Instructions); 4. Quantitatively managed; and 5. Optimizing - process management includes deliberate process optimization/improvement]	
Cmm1 – What is the level of project integration management of your organization?	1 2 3 4 5
Cmm2 – What is the level of project scope management of your organization?	1 2 3 4 5
Cmm3 – What is the level of project time management of your organization?	1 2 3 4 5
Cmm4 – What is the level of project cost management of your organization?	1 2 3 4 5
Cmm5 – What is the level of project quality management of your organization?	1 2 3 4 5
Cmm6 – What is the level of project human resource management of your organization?	1 2 3 4 5
Cmm7 – What is the level of project communications of your organization?	1 2 3 4 5
Cmm8 – What is the level of project risk management of your organization?	1 2 3 4 5
Cmm9 – What is the level of knowledge management of your organization?	1 2 3 4 5
Financial Resources	
Fin1 – Your organization has the financial resources to support the project.	1 2 3 4 5 6 7
Fin2 – In the context of your organization's overall project budget, the cost of your project would be significant.	1 2 3 4 5 6 7
Technical Knowledge	
Kno1 – Project team members are knowledgeable of project management tools.	1 2 3 4 5 6 7
Kno2 – Project team members know how to evaluate project management risks.	1 2 3 4 5 6 7
Kno3 – Project team members possess knowledge of portfolio management techniques.	1 2 3 4 5 6 7
IT Project Performance	
Per1 – Projects are completed on time.	1 2 3 4 5 6 7
Per2 – Projects met budget requirements.	1 2 3 4 5 6 7
Per3 – Projects met expectations.	1 2 3 4 5 6 7
Per4 – Project team members are satisfied to work together.	1 2 3 4 5 6 7
Per5 – Benefits of projects to the organization are high.	1 2 3 4 5 6 7
Per6 – Projects resulted in sales growth.	1 2 3 4 5 6 7
Per7 – Projects helped the organization to increase market share.	1 2 3 4 5 6 7
Per8 – Projects helped the organization improve its competitive position.	1 2 3 4 5 6 7

Table 2: Reliability, Factor Loadings and Convergent Validity

Construct (reliability)	Indicator	Loadings	Convergent Validity (t-statistics)
Competent project managers (0.84)	Cpm1	0.83	11.56
	Cpm2	0.84	13.67
	Cpm3	0.82	11.98
Process Maturity (0.86)	Cmm1	0.82	13.18
	Cmm2	0.83	14.05
	Cmm3	0.84	13.98
	Cmm4	0.85	15.21
	Cmm5	0.82	12.15
	Cmm6	0.82	12.33
	Cmm7	0.80	9.64
	Cmm8	0.84	15.13
	Cmm9	0.82	11.15
Financial resources (0.83)	Fin1	0.82	11.82
	Fin2	0.81	11.73
Technical knowledge (0.81)	Kno1	0.81	10.97
	Kno2	0.78	9.07
	Kno3	0.79	10.24
Competitive pressure (0.83)	Com1	0.81	10.79
	Com2	0.82	11.92
	Com3	0.80	9.97
	Com4	0.79	9.25
Regulatory pressure (0.82)	Reg1	0.80	10.24
	Reg2	0.82	11.71
Overall IT project performance (0.85)	Per1	0.88	18.30
	Per2	0.81	11.43
	Per3	0.76	8.94
	Per4	0.85	16.18
	Per5	0.76	9.27
	Per6	072	8.54
	Per7	0.84	14.70
	Per8	0.81	11.56

Stand-alone indices (LISREL) were used to test convergent validity and these indices are based on the maximum likelihood function [38]. Stand-alone indices consist of goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), incremental fit index (IFI), competitive fit index (CFI), root-mean-square-error of approximation (RMSEA), χ^2, λ^2/df, and Critical N. A maximum cutoff value close to 0.06 is recommended for RMSEA [38]. Bollen [8] suggests a minimum cutoff value close to 0.9 for GFI, AGFI, IFI, and CFI. The χ^2 value should be significant at the 0.05 level [47]. A Critical N that is lower than the actual sample size in CFA shows that CFA has sufficient power to detect problems causing poor fit [42].

Table 3 shows a summary of CFA measures for our data (see Table 3) suggesting that the RMSEA (0.047) and the χ^2 (significant at level of 0.01) values meet the requirements for good fit. Additionally, the GFI, AGFI, CFI, and IFI values were all above the minimum cutoff value of 0.90. The Critical N value of 283 is also below the respective sample sizes of 433, illustrating that the conceptual model is a good fit. Thus, all constructs and scale items used in this study have adequate convergent validity.

Discriminant validity is the degree to which measures of different latent variables are unique and in other words, the variance in the measure should reflect only the variance attributable to its intended latent variable and not to other latent variables [36]. According to Spector [74], scale items measuring different constructs should have low correlations if a construct meets the requirement of discriminant validity.

Results from the discriminant validity analysis are shown in Table 4. We employed CFA to assess the discriminant validity (χ^2 difference test using a significance of $p = 0.01$ level). Results from the χ^2

difference test indicate that for each of these three pairwise comparisons, the χ^2 difference between the unconstrained model and the constrained model was significant at the p = 0.01 level. Thus, all three constructs are related but conceptually present distinct traits, thus they meet the requirement of discriminant validity.

Table 3: Summary of Fit Indices for the Research Model[a]

Recommended Values	χ^2	GFI	AGFI	CFI	IFI	RMSEA	Critical N
	(p < 0.01)	> 0.90	> 0.90	> 0.90	> 0.90	< 0.06	< 433
Research Model	126.37**	0.93	0.91	0.94	0.93	0.05	283

[a]Notes: GFI = goodness-of-fit index, AGFI = adjusted goodness-of-fit index, CFI = comparative fit index, IFI = incremental fit index, and RMSEA = root mean square error of approximation. **p<0.01

Table 4: Results of Discriminant Validity – $\chi 2$ Difference Test

	χ^2 Values		
Pairwise Construct comparison	Unconstrained	Constrained	Difference
Operational Capabilities vs.			
Project performance	77.27	84.73	18.16[a]
Environmental Pressure	53.83	72.92	13.60[a]
Project performance			

[a] Significant at p = 0.01 level

RESULTS

Table 5 shows the correlation matrix for the variables examined in the study and determinant value of 0.0231 indicating there is not a multicollinearity issue. In order to test the hypotheses developed above, structural equation modeling (SEM) was used to determine whether or not operational capabilities acts as a mediating variable [67]. Four sets of mediation models were tested looking at four dimensions of operational capabilities. Results are shown in Table 6. For hypothesis 1, the total effect for environment pressure (EP), 0.6183, is the effect found if there was no mediator in the model. It is significant with a z score of 10.17. The direct effect for EP is 0.3349 which while still significant (z = 8.06), is much smaller than the total effect. The indirect effect of EP that passes through financial resources (FR) is 0.2834 and is also statistically significant (z = 6.42). As such, the proportion of the total effect mediated equals to 0.4584 (i.e., 0.2834/0.6193) indicating a strong significant mediation effect. Thus, hypothesis 1 that a firm's financial resources mediate the relationship between environmental pressures and IT project performance is supported.

By the same token, the results shown in Tables 6b, 6c and 6d support hypotheses 2, 3 and 4. Thus, technical knowledge, project manager competency, and capability maturity level each mediate the relationship between environmental pressures and IT project performance.

Table 5: Correlation Matrix

	Mean	S.D.	1	2	3	4	5	6	7
1. Competent project managers	3.75	.37	1						
2. Process Maturity*	3.48	.28	0.13	1					
3. Financial resources	4.27	.35	0.04	0.15	1				
4. Technical knowledge	4.43	.46	0.08	0.14	0.06	1			
5. Competitive pressure	5.28	.50	0.05	0.06	0.04	0.05	1		
6. Regulatory pressure	5.15	.47	0.04	0.06	0.04	0.06	0.04	1	
7. Overall project performance	4.08	.52	0.25	0.47	0.11	0.12	0.13	0.13	1

*on a scale of 1-5
Determinant = 0.0231

Table 6a: Mediation Result (Finance Resources) [a]

	Coef.	Std. Err	Z	P>|z|	[95% Conf. Interval]	
Direct Effects						
Structural						
FR <-						
EP	0.5176	0.0652	11.23	0	0.3247	0.5619
PP <-						
FR	0.2625	0.0531	6.34	0	0.2031	0.4205
EP	0.3349	0.0608	8.06	0	0.2418	0.4876
Indirect Effects						
Structural						
FR <-						
EP	0	(no path)				
PP <-						
FR	0	(no path)				
EP	0.2834	0.0573	6.42	0	0.2276	0.4467
Total Effects						
Structural						
FR <-						
EP	0.5176	0.0652	11.23	0	0.3247	0.5619
PP <-						
FR	0.2625	0.0531	6.34	0	0.2031	0.4205
EP	0.6183	0.05834	10.17	0	0.3958	0.9233

[a]Notes:
IV: Environmental Pressure (EP)
MV: Financial Resources (FR)
DV: Project Performance (PP)
CVs: Firm Size, Industry, and Country

Table 6b: Mediation Result for Technical Knowledge

	Coef.	Std. Err	Z	P>|z|	[95% Conf. Interval]	
Direct Effects						
Structural						
FR <-						
EP	0.4373	0.0858	8.61	0	0.2973	0.5034
PP <-						
FR	0.2075	0.0662	4.36	0	0.1691	0.3078
EP	0.2235	0.0730	5.13	0	0.2036	0.2947
Indirect Effects						
Structural						
FR <-						
EP	0	(no path)				
PP <-						
FR	0	(no path)				
EP	0.2315	0.0746	5.31	0	0.2139	0.3106
Total Effects						
Structural						
FR <-						
EP	0.4373	0.0858	8.61	0	0.2973	0.5034
PP <-						
FR	0.2075	0.0662	4.36	0	0.1691	0.3078
EP	0.4550	0.0637	8.35	0	0.3712	0.6756

[a]Notes:
IV: Environmental Pressure (EP)
MV: Technical Knowledge (TK)
DV: Project Performance (PP)
CVs: Firm Size, Industry, and Country

Table 6c: Mediation Result for Project Manager Competency[a]

	Coef.	Std. Err	Z	P>|z|	[95% Conf. Interval]	
Direct Effects						
Structural						
FR <-						
EP	0.5012	0.0603	10.15	0	0.3235	0.6357
PP <-						
FR	0.2263	0.0572	6.78	0	0.1738	0.3329
EP	0.2931	0.0313	7.86	0	0.2284	0.3517
Indirect Effects						
Structural						
FR <-						
EP	0	(no path)				
PP <-						
FR	0	(no path)				
EP	0.2521	0.0562	7.04	0	0.2043	0.3188
Total Effects						
Structural						
FR <-						
EP	0.4373	0.0858	8.61	0	0.2973	0.5034
PP <-						
FR	0.2075	0.0662	4.36	0	0.1691	0.3078
EP	0.5452	0.0523	9.86	0	0.3935	0.7056

[a]Notes:
IV: Environmental Pressure (EP)
MV: Project Manager Competency (PMC)
DV: Project Performance (PP)
CVs: Firm Size, Industry, and Country

Table 6d. Mediation Result for Process Maturity Level[a]

	Coef.	Std. Err	Z	P>|z|	[95% Conf. Interval]	
Direct Effects						
Structural						
FR <-						
EP	0.4943	0.06893	9.27	0	0.3574	0.5628
PP <-						
FR	0.2122	0.06213	5.38	0	0.1561	0.2943
EP	0.2305	0.05616	6.31	0	0.1954	0.3023
Indirect Effects						
Structural						
FR <-						
EP	0	(no path)				
PP <-						
FR	0	(no path)				
EP	0.2724	0.05928	6.04	0	0.2247	0.3257
Total Effects						
Structural						
FR <-						
EP	0.4373	0.0858	8.61	0	0.2973	0.5034
PP <-						
FR	0.2075	0.0662	4.36	0	0.1691	0.3078
EP	0.5029	0.0473	9.47	0	0.4268	0.7354

[a]Notes:
IV: Environmental Pressure (EP)
MV: Process Maturity Level (PML)
DV: Project Performance (PP)
CVs: Firm Size, Industry, and Country

DISCUSSION

Theoretical and Managerial Implications

This study has explored how the alignment of operational capabilities and environmental pressures affect project performance from a mediation perspective. Although prior studies have found that environmental pressures affects IT project performance [4, 19, 53, 70], our study is the first to examine the mediating effects of operational capabilities on this relationship. The results suggest that all four dimensions of operational capabilities mediate the relationship between environmental pressures and IT project performance.

Overall, the findings from this study support the four hypotheses tested. These findings have significant implications for both managerial practitioners and academic researchers. From a theoretical perspective this study underscores the importance of exploring mediating variables in project management research. Without exploring the mediating variable in this study, the unique relationship between environmental pressure and operational capabilities would not have been revealed. It is only by exploring the impact of the one or more mediating variables that the significant relationships reflected in them are observed.

Our findings also indicate that environmental pressures affect operational capabilities, which in turn affect project performance. These findings extend the work of several studies that have examined the effects of operational capabilities (i.e., financial resources, technical knowledge, project manager competency, and process maturity level) on project performance (i.e., [23, 56, 70]) by showing how operational capabilities mediate the relationship between environmental pressures and project performance. These findings also extend the work of Gu et al. [30] which found that the relationship between organizational culture and IT project performance is moderated by environmental pressures.

As mentioned above, most if not all organizations are systems made up of several moving parts that function at different levels of the organization. Even though these parts function at different levels of the organization they are still very inter-twined. Because of this, looking at only how the parts of the system at the same level in the organization interact does not provide a complete picture of how the organizational system functions as a whole. Thus, the current study examined how multi-level parts of the system interact with each other to affect performance at different levels of an organization. We believe that this approach is important and mimics the real world business operations. As such, it is one of the few studies that actually examine how multi-level parts of the system interact with each other to affect performance at different levels of an organization.

From a managerial perspective it demonstrates that operational and environmental factors can interact closely in a manner that impacts project performance. Thus, it is important for managers to be mindful about these particular operational capabilities when carrying out projects in highly competitive or highly regulated environment. Although environment pressures is shown to directly impact the project outcome, a significant portion of this impact is through the degree of the financial support a project receives, or the level of the organizational process maturity, the level of project manager's competency as well as project team's technical knowledge. Therefore, decisions need to be made to align with a specific environment the project faces. For example, the financial resources granted by local governments to road construction contractors for long-term projects can be shown in our research model to have a direct effect on the success or failure of a road project (i.e., project performance). Those same local governments may have to alter financing decisions of some road projects because of a changed regulatory environment faced over the long-term (e.g., new transportation and/or environment protection regulations on city highway construction projects), which in turn could impact the outcome of these projects.

Limitations

Research efforts in the management field often utilize cross-sectional research designs. In the current study a cross-sectional design was utilized because it enables us to examine the effect of operational and environmental factors on project performance across industries in two distinct cultures, rather than in a specific industry. Utilizing a cross-sectional design also allowed us to obtain a sample size sufficient for analysis which was a concern due to the unit of analysis being an organization. Unfortunately, a cross-sectional design is like a snapshot in time and is limited in that it does not provide as good of basis for establishing causality as does a longitudinal research design. Because of this limitation, when feasible, future research efforts might consider utilizing a longitudinal research design when examining the impact of operational and environmental factors on project performance.

The fact that all measuring instruments used in this research are based on managers' perceptions is another limitation associated with the current study. Although this is a widely used and valid operational process for measuring various constructs [10], all questionnaire surveys are limited by the truthfulness of the respondents. Fortunately, the validation and reliability analyses undertaken in this study do provide some level of assurance of the instrument's ability to capture useful measures.

CONCLUSIONS

Overall, the goal of this study was to examine the mediating effects of operational capabilities on the relationship between environmental pressure and IT project performance. Specifically, drawing on project management literature, the current study found that operational capabilities mediate the relationship between environmental pressure and IT project performance. It is hoped these findings will aid firms in making decisions that will improve project performance by encouraging managers to become aware of how environmental pressure affects operational capabilities which in turn affect IT project performance. Additionally, it is hoped our study will provide direction for future research efforts in this area.

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