Environmental pressure and project performance relationships: moderating and mediating effects of operational capabilities

Abstract

This study explores how operational capabilities affect the relationship between environmental pressure and information technology (IT) project performance. Specifically, the study examines 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.

Keywords: project management, operational capabilities, resource-based view, environmental pressure

1. Introduction

Interest in studying project management in organizations has grown considerably over the last few years. Despite the advancement of project management knowledge, the establishment of project management standards, and increased availability of project management resources for organizations under the leadership of the Project Management Institute during the last two decades, the majority of projects still fail (Yazici, 2009). Project failure has been synonymous with many IT projects. For example, Gray and Larson (2003) found software development projects are often completed over budget and behind schedule. Additionally, the Standish Group Survey (2009) found the overall project failure rate to be 72 percent in the US. Because of the high rate of project failure, researchers have explored the potential determinants that might lead to their success or failure.

Literature examining the underlying reasons impacting project success and failure reflects diverse interests in various domain areas. Most of these studies have been conducted in the US or other countries with a Western culture (e.g., Schmidt et al., 2001) or with a set of particular domain factors in countries with distinctive cultures. Schmidt et al. (2001) conducted a well-known and comprehensive assessment of multiple risk factors of software project management by using the Delphi method with a panel of experts from three different countries (i.e., US, Hong Kong and Finland). The study provided

general consideration guidelines for project teams and organizations when conducting software projects at both strategic and operational levels.

Although a substantial body of literature has focused on project performance, to date no study has examined how the alignment between environmental pressure and operational capabilities affect project performance. Within the context of the current study, alignment is viewed innovatively from two different perspectives. One is the moderation perspective, where interaction between two independent variables affects a dependent variable. The other perspective is mediation, where there is an intervening (mediating) variable between an antecedent and dependent variable.

While alignment has been frequently studied (e.g., Joshi et al. 2003, Cao and Schniederjans 2004, Schniederjans and Cao 2009, Cao and Hoffman 2011), little research exists about how operational capabilities affect the relationship between environmental pressure 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 operations management research that has examined alignment (Joshi et al. 2003, Cao and Schniederjans 2004, Schniederjans and Cao 2009, Cao and Hoffman 2011) by investigating whether operational capabilities mediate or moderate the relationship between environmental pressure and information technology (IT) project performance. Specifically, the current study examines 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.

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

2. Literature Review

2.1. The effect of environmental pressure on project performance

A wealth of research suggests that the firm's external environment is theoretically and empirically linked to performance (Porter, 1980). The environment includes the industry context, the macroeconomic context, and other national and cultural factors (Chan and Reich, 2007). Organization theorists generally agree organizations with greater power over their environments are better able to function and survive than their less powerful counterparts (Thompson, 1967).

Exploring critical risk factors in project performance, it is apparent several studies have identified that environment plays an influencing role. Ling et al. (2009) suggested foreign project management practice can be affected by an operating environment in a different country, thus leading to different project performance outcomes. In another study Schmidt et al. (2001) found an unstable corporate environment, caused by such factors as competitive pressure, can radically alter user requirements and at times can make an entire project obsolete.

Badri et al. (2000) pointed out that in addition to competitive pressure, different government regulations or policies are part of the business environment that can affect firms. Thus, when comparing project performance in different countries, the business environment should be considered. This research is supported by Darnall (2009) who found regulatory pressure constrains an organization's financial opportunities, while other regulations spur product and technology innovations, as well as encourage greater operational efficiencies.

2.2. The effect of operational capabilities on project performance

Traditionally, research on project performance has focused on the project manager's individual leadership or on investigating organizational factors (Yazici, 2009, Al-Ahmad et al., 2009). One organizational factor that has received attention is the impact of operational capabilities on project performance (Schmidt et al., 2001). The idea that operational capabilities can affect organizational performance, including project performance, is supported by the resource-based view (RBV) of the firm (Barney, 1991), which states a firm's resources are part of the firm's capability attributes that support business strategy and operational activities.

The resource-based view (RBV) of the firm has been a common interest of management researchers since it was first presented. As early as 1959, Edith Penrose argued that a firm is a collection of productive resources and also an administrative decision making unit controlling the allocation of those productive resources (Penrose, 1959). Wernerfelt (1984) coined the term and defined resources as "those assets that are tied semi-permanently to the firm." Most scholars consider Barney's resource theory as the modern RBV of the firm. Barney (1991) suggests there can be heterogeneity or firm-level differences that allow some to create a competitive advantage. 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 company to conceive and implement strategies that improve efficiency and effectiveness (Barney, 1991).

As mentioned above, in the current study we focus on operational capabilities, specifically financial resources, process maturity, project manager competency, and technology knowledge. In the sections below, literature establishing the link between each of these operational capabilities and project

performance is reviewed. Hypotheses regarding how each of these operational capabilities moderates or mediates the relationship between environmental pressure and project performance are then developed and put forth.

2.2.1. Financial resources and project performance

A firm's financial resources are part of its capability attributes that support business strategy and operations activities. The resource-based view (RBV) of the firm clearly indicates a firm's financial assets contribute tangibly to performance. Although the project management literature has not focused attention on investigating whether a firm's financial resources are critical toward project performance, due to funding issues, Schmidt et al. (2001) did point out that funding, related to project development and product maintenance, is a risk factor for project performance. Additionally, a study by Dulaimi et al. (2005) shows senior management should provide adequate resources and sustained support for innovation, because they increase the success rate of projects. In another study Liu and Yetton (2010) found that sponsorships are linked to IT project success. Based on this research it can be theorized that financial resources have a positive effect on IT project performance.

2.2.2. Technical knowledge, project manager competency and project performance

The resource-based view of the firm (RBV) also suggests that knowledge is a type of resource. Significance of knowledge is widely recognized as a primary resource that can increase an organization's competitive advantage (Lee et al. 2011).

In the current study *technology knowledge* is related to project members' knowledge of methodologies, and *project manager competency* is related to understanding of the business and people management skills. The importance of technical and business skills, as well as knowledge of information systems personnel has been advocated in the IS literature for decades. For example, Byrd and Turner

(2001) employ perceptions of chief information officers (CIOs) to evaluate IS personnel skills. The study found technical skills to be strongly related to the success measures selected.

A review of literature by Bharadwaj and Saxena (2005) and an empirical study by Fink and Neumann (2007) found technical and managerial knowledge were positively related to planning in IT project performance. Chinowsky et al. (2008) also found both technical and managerial knowledge are required for effective and higher performing engineering and construction projects. Similarly, Doloi (2009) found both technical and managerial knowledge, including people skills, risk management and business skills, are significantly related to contractor project performance (i.e., the higher the knowledge level, the higher the project performance). Additionally, a survey by Schmidt et al. (2009) found a positive relationship between a project manager's technical ability to evaluate project factors (e.g., risk) and overall project performance in new product development. Using an international Delphi method, Schmidt et al. (2001) also identified eleven common risk factors associated with IT software project performance and found that the lack of knowledge, including technical and business knowledge, of project personnel was ranked highly on the risk factor list. Based on these research findings it can be theorized that technical knowledge of personnel has a positive effect on IT project performance. It can also be theorized that project manager competency has a positive effect on IT project performance.

2.2.3. Process maturity level and project performance

There has been much interest in the project management literature regarding the relationship between an organization's project management process maturity level and project performance (Mullaly, 2006). Understanding its impact on project performance is critical to both academics and practitioners.

One of the most prominent models pertaining to process maturity is the Capability Maturity Model (CMM). CMM was first described in 1989 *Managing the Software Process* by Watts Humphrey. Hence, it is also known as "Humphrey's CMM". In the Capability Maturity Model, Humphrey (1989)

states the process capability maturity of an organization can greatly affect technology change, whether in software development or areas such as software engineering, project management, software maintenance and/or risk management.

Another process maturity model is the stage maturity model proposed by Nolan (1973) and further developed by the Software Engineering Institute (SEI, 2002) at Carnegie Mellon University. This model stipulates five process maturity levels defined along the continuum of CMM. In this stage maturity model, each level ranks the organization according to its standardization of processes in the subject area being assessed. SEI states, "Predictability, effectiveness, and control of an organization's software processes are believed to improve as the organization moves up these five levels. While not rigorous, the empirical evidence to date supports this belief" (SEI, 2002).

A variety of maturity models have been developed to support a range of functions, since the popularization of CMM and its siblings by SEI (Holland and Light, 2001; De Vries and Margaret, 2003; Garrett and Rendon, 2005). These models adopted the framework and structure established by CMM with five levels and a number of capability areas serving as the focus for assessment. However, there is little research or conclusive findings regarding the degree to which maturity models actually support improvement in project or organizational results (Mullaly, 2006).

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 (Kwak and Ibbs, 2000). A recent study by Yazici (2009) found that CMM is significantly related to business performance, but not to project performance.

One reason for this lack of consensus may be due to the prior use of several different models to examine process maturity. To extend our understanding of the potential mediating or moderating effects of process maturity on the relationship between environmental pressure and project performance, our study examines the five levels of CMM that provide relevance for project organizations. CMM was chosen for our study, because it is one of the most recognized and accepted process maturity models currently in use. Specifically, we theorize that higher organizational process maturity level has a positive effect on IT project performance.

3. Hypothesis development

3.1. Alignment

Alignment is a broad topic and has been a focus of researchers in the fields of business strategy, operations management, and information systems for a number of years. The concept of alignment originally developed from the idea that businesses should strive to "match" or "align" their resources to the competitive context in which the business is situated (Drazin and Van de Ven 1985; Venkatraman and Prescott 1990). Early research on this topic highlighted the importance of aligning business strategy with internal organization strengths and the external environment (Ansoff 1965, Andrews 1971).

3.2. The effect of the alignment between environmental pressure and operational capabilities on project performance

Research pertaining to how the alignment between operational capabilities and environmental pressure affect project performance indicates operational capabilities may influence the relationship between organizational resources and performance in several ways. Specifically, it has been theorized the competitive environment becomes more important where environmental uncertainty exists (Chan et al., 2006), in highly-competitive industries (Peak et al., 2005), and where government regulations alter competition (Peak et al., 2005).

Several prior research efforts have also suggested environmental factors may interact with operational capabilities in a manner that affects project performance. For example, in a field study of 76 technology-based project teams, Thamhain (2004) found the environment in which the project team operates can influence team performance. Additionally, Barua et al. (1996) found that project processes need to be modified in order to meet changes in a business environment. Conversely, if processes are left unchanged, the organization will not perform as well in a volatile competitive environment. In a case study Clark (1999) observed that competitive pressure requires changes in project processes in order to improve the "bottom line" in the performance of contracted project services. Clark (1999) also found competitive pressure modifies the performance outcomes of projects.

In another study involving a survey Hong and Schniederjans (2000)empirically demonstrated the impact that global competitive pressure can have on new project development performance. They also found the size of the project is less important than factors such as balancing technology and human resources. More recently, Gupta et al. (2007) found competitive pressure is actually an enabler of IT in organizations. They found a positive relationship between competitive pressure and business performance.

3.3. Do operational capabilities mediate or moderate the relationship between environmental pressure and project performance?

As mentioned earlier, little research has examined how operational capabilities should be included in research models, and the question as to whether operational capability serves as a mediating or moderating variable in this relationship has not been thoroughly addressed. Within this context a moderating variable is viewed as affecting the direction and/or strength of the relationship between an independent variable and a dependent variable. Specifically, within a correlational analysis framework a moderator is viewed as a third variable affecting the zero-order correlation between two other variables. A basic moderator effect can be represented as an interaction between a focal independent variable and a

factor that specifies the appropriate conditions for its operation (Baron and Kenny, 1986). In contrast a given variable functions as a mediator to the extent that it accounts for the relation between the predictor and the criterion. Mediating variables can explain how external factors take on internal significance. Whereas moderator variables specify when certain effects will hold, mediators speak to how or why such effects occur (Baron and Kenny, 1986).

Another way to consider the difference between mediating and moderating variables is that a moderator variable is one that influences the strength of a relationship between two other variables and a mediator variable is one that explains the relationship between the two other variables. In the the current study operational capability might be a moderator variable, whereby the relationship between environmental pressure and project performance would be stronger for firms with less operational capabilities. On the other hand the relationship would be less strong or nonexistent for firms with more operational capabilities. Operational capability might be a mediator variable in that it explains why there is a relationship between environmental pressure and project performance. In the case of mediation, when you remove the effect of operational capability, the relationship between environmental pressure and project performance would disappear.

The literature reviewed above makes a solid case that the alignment between environmental pressure and operational capabilities impact project performance. However, it is less clear if operational capabilities act as mediating or moderating variables in terms of their impact on the relationship between environmental pressure and project performance. Based on the literature an argument can be made that operational capability is a moderator variable if the relationship between environmental pressure and project performance is stronger for firms with less operational capabilities and less strong or nonexistent for firms with more operational capabilities. We believe, however, based on the literature that a stronger argument can be made that operational capabilities are mediating variables whereby they explain why

there exists a relationship between environmental pressure and project performance. Although prior studies have indicated that the environment does directly affect firm level performance, we theorize that at the project performance level environmental pressure affects operational capabilities, which in turn affect project performance. Specifically, we theorize that when you remove the effects of operational capabilities, the relation between environmental pressure and project performance disappears).

In order to test our theory the following hypotheses are put forth:

H1. A firm's financial resources mediates the relationship between environmental pressure and IT project performance.

H2. The amount of technical knowledge mediates the relationship between environmental pressure and IT project performance.

H3. The amount of a project manager's competency mediates the relationship between environmental pressure and IT project performance.

H4. Process maturity mediates the relationship between environmental pressure and IT project performance.

4. Methods

4.1. Sample

Data were collected from the United States and China due to their distinctive characteristics related to culture, capabilities and environment. The unit of analysis in this study is the organization, and as such, the subjects for this study are the project professionals within the organizations. They include project managers, program executives, project coordinators, systems analysts, IT managers, and project consultants. For the US survey an initial sample of firms for inclusion was randomly selected from the 2007 North American Industry Classification System (NAICS) Manual (2007). Surveys were mailed to firms in five different industries: retail trade; information; finance and insurance; professional scientific and technical services; health care and social assistance. For the Chinese survey a random sample of firms in these five industries were chosen based on the International Standard Industrial Classification (ISIC) codes.

A total of 1,000 questionnaires were distributed in a single mailing in the US. Out of 198 responses 172 were usable, resulting in an actual response rate of 17.2%. A single mailing of 1,000 questionnaires was also conducted in China. Out of 285 responses 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. These response rates are not unusual when the unit of analysis is the firm, and the questionnaire involves extensive organizational level questions (Griffin, 1997).

To examine 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 (Flynn et al., 1994).

4.2. Variables and measurement

This study used a two-part research design in order to increase the reliability and validity of the data collected. Part one involved constructing a questionnaire. This process began with reviewing and analyzing previous literature and then developing the theoretical framework. These steps have been reported in the previous sections of this paper. The next step involved constructing the questionnaire. Our research model included three constructs: project capabilities, environmental pressure, and IT project performance. The manner in which each of these constructs is measured is discussed below.

The project capabilities construct consisted of four dimensions: CMM model, financial resources, technical knowledge, and project manager competency. The items for the CMM dimension were based on those used in previous CMM research (Yazici, 2009). The items for the financial resources dimension were adapted from a study of RFID implementation (Lee and Shim, 2007). The items for the technical knowledge dimension were adapted from those used in a study of e-commerce adoption (Shehu and Akintoye, 2010). The measurement of the project manager competency dimension was adapted from prior research (Kendra and Taplin, 2004). Based on prior literature (Luo and Park,

2001; Choe, 2003; Peak et al., 2005) the environmental pressure construct was measured by including questions on the survey pertaining to both competitive and regulatory pressure.

The dependent variable (i.e., project performance) items were adopted from Nidumolu (1995). Items included: projects met budget requirements; projects met expectations; project team members are satisfied to work together; benefits of projects to the organization are high; projects resulted in sales growth; projects helped the organization to increase market share; projects helped the organization improve its competitive position. It is important to note that not all of the Nidumolu (1995) items or dimensions were selected for this study. Those particular items selected from Nidumolu (1995) covered several dimensions from his study and were grouped into a unidimensional variable for this study. The items selected to represent product performance were those similarly found in other project management studies, such as Patanakul et al. (2010), and Jha and Iyer (2007). In addition to the variables above, firm size and industry effects were controlled using dummy variables (Gujarati, 1970).

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 29 items were used to measure the constructs in our proposed models (see Appendix).

After assembling a preliminary version of our instrument based on prior literature, we then conducted interviews with key project professionals. After completing these steps a series of questions addressing the key variables used in the study were developed. A pilot study was conducted by distributing the preliminary questionnaire to the project professionals of several companies in a Midwestern city located in the United States. They 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 feedback received in this pilot study minor adjustments were made in the instrument before conducting the survey.

4.3. Instrument validation

In this study overall instrument validity was assessed by evaluating the results of content, criterion-related, convergent, construct validities, and reliability tests (Boudreau et al., 2001). As noted earlier, the preliminary questionnaires were sent to and examined by a panel of project professionals in various organizations. The questionnaire was then modified based on the input of the panel of experts. Content validity was thus established by carefully defining the topic of concern, describing items to be scaled, developing the scales to be used, and using a panel of experts to judge the quality of the instrument.

Criterion-related validity is the degree to which the survey instrument correlates with one or more criteria. The expected cross validity index (ECVI) is one measure for criterion-related validity (Kline, 1998). The ECVI values of all constructs (largest being 0.87) in this research were well below the value of 1 that has been described as "adequate". This study employed confirmatory factor analysis (CFA) in linear structural relations (LISREL) to test the uni-dimensionality of the constructs. Standardized loadings for scale items ranged from 0.72 to 0.88. These CFA loading results were in the moderate-to-high range. Moreover, *t*-values for scale items ranged from 8.54 to 18.31, exceeding the 2.0 rule-of-thumb. As a result, all loadings for scale items were significant ($p < 0.01$).

Convergent validity concerns the degree to which multiple methods of measuring a variable provide the same results. Stand-alone indices (LISREL) are used to test convergent validity. They are based on the maximum likelihood function, which performs much better than indices derived from the generalized least squares approach (Hu and Bentler, 1998). Stand-alone indices include 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. Hu and Bentler (1998) recommended a maximum cutoff value close to 0.06 for RMSEA. A minimum cutoff value close

to 0.9 is suggested for GFI, AGFI, IFI, and CFI (Bollen, 1989). The χ^2 value should be significant at the 0.05 level (Kline, 1998). Critical N allows research to assess the fit of a model relative to identical hypothetical models estimated with different sample sizes (Hoelter, 1983). Critical N is computed based on the Chi square (χ^2) and its degrees of freedom. 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 (Jöreskog and Sörbom, 1993).

The CFA measures of the conceptual model for our data indicated that the RMSEA (0.047) and the χ^2 (significant at level of 0.01) values met the requirements for good fit. All GFI, AGFI, CFI, and IFI values also exceeded the minimum cutoff value of 0.90. Critical N value (283) was lower than the respective sample sizes of 433, indicating that the conceptual model is a good fit. All constructs and scale items used in this study thus met the requirements for adequate validity.

Discriminant validity is the degree to which measures of different latent variables are unique (Hensley, 1999). That is, in order for a measure to be valid, the variance in the measure should reflect only the variance attributable to its intended latent variable and not to other latent variables. If a construct has discriminant validity, scale items measuring different constructs should have low correlations (Spector, 1992). CFA was employed to assess the discriminant validity (χ^2 difference test using a significance of $p = 0.01$ level).

Results from a discriminant validity analysis using 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. As a result, all three constructs are related but conceptually present distinct traits.

Cronbach's alphas were calculated for all constructs and dimensions in the conceptual model (Flynn et al., 1990). Cronbach's alpha is the most widely used method of reliability assessment in

business research (Chau, 1999) and is based on the correlations among the indicators that comprise a measure with higher correlations among the indicators associated with high alpha coefficients (Pedhazur and Schmelkin, 1991). The Cronbach's alpha values for the US survey all exceeded the suggested value of 0.70 generally considered adequate for assessing reliability in empirical research (Nunnally, 1978). The scale items used in this research can thus be considered reliable.

5. Results

5.1. Results

Table 1
Correlation matrix

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

Table 1 shows the correlation matrix for the variables examined in the study. In order to test the hypotheses developed above, a set of three regression models was used to determine whether or not

operational capabilities act as mediating variables. To test for mediation, it was necessary to estimate the following regression equations: first, regressing the mediator on the independent variable; secondly, regressing the dependent variable on the independent variable; third, regressing the dependent variable on both the independent variable and on the mediator. Separate coefficients for each equation should be estimated and tested. In the present study, we regressed (1) competitive environment (CE) on operational capabilities (OC), (2) project performance (PP) on operational capabilities (OC), and (3) project performance (PP) on competitive environment (CE) and then on operational capabilities (OC).

These regression equations provide the tests of the linkages of the mediational model (as shown in Figures 1a – competitive pressure and 1b – regulatory pressure). To establish mediation, the following conditions must hold: first, the independent variable must affect the mediator in the first equation (CE ␣ OC); secondly, the independent variable must be shown to affect the dependent variable in the second equation (CE ␣ PP); third, the mediator must affect the dependent variable in the third equation (OC ␣ P). If these conditions all hold in the predicted direction, then the effect of the independent variable on the dependent variable must be less in the third equation than in the second (CE ␣ PP, when controlling for OC < CE ␣ P). Perfect mediation holds if the independent variable (OC) has no effect when the mediator (CE) is controlled. In all we tested eight sets of mediation models looking at two dimensions of competitive environment and four dimensions of operational capabilities.

	Mediation effect (β, p)	Direct effect (β, p)

	1a ▭ 2 ▭ 6 (0.08, 0.03)*	1 ▭ 6 (0.04, 0.28)
	1a ▭ 3 ▭ 6 (0.07, 0.05)*	1 ▭ 6 (0.02, 0.43)
	1a ▭ 4 ▭ 6 (0.04, 0.11)	1 ▭ 6 (0.01, 0.72)
	1a ▭ 5 ▭ 6 (0.06, 0.06)*	1 ▭ 6 (0.02, 0.35)

Figure 1a – Research model (Mediation Results – Competitive Pressure – 1a)
*: Effect size is β significant if p value < 0.10

	Mediation effect (β, p)	Direct effect (β, p)
	1b ▭ 2 ▭ 6 (0.09, 0.02)*	1 ▭ 6 (0.04, 0.31)

	1b ▭ 3 ▭ 6 (0.08, 0.03)*	1 ▭ 6 (0.02, 0.47)
	1b ▭ 4 ▭ 6 (0.03, 0.09)*	1 ▭ 6 (0.01, 0.87)
	1b ▭ 5 ▭ 6 (0.06, 0.05)*	1 ▭ 6 (0.02, 0.41)

Figure 1b – Research model (Mediation Results for Regulatory Pressure – 1b)
*: Effect size is β significant if p value < 0.10

For conciseness, we only report the significant mediation effects ($p < 0.10$) and their associated direct effects. Figures 1a and 1b present each significant mediation effect with one exception (project manager competency under competitive pressure). As such, the results provide partial support for fit as mediation. For instance, competitive pressure affected each dimension of operational capabilities except project manager competency, which in turn affected project performance. Regulatory pressure affected all dimensions of operational capabilities, which then impacted project performance. Altogether, there were seven significant mediation effects ($p > 0.10$), whereas none of the corresponding direct effects were significant at the level of 0.10.

Among all the possible direct effects from competitive environment to project performance, not a single effect was significant. Evidently, the mediation effects seemed to dominate the direct effect. These

results suggest that broad implementation of practices oriented toward enhancing operational capabilities is an important means for dealing with the competitive environment pursued by the firm. These results also support hypotheses 1, 2, & 4 and provide partial support for hypothesis 3.

In addition to testing for mediation, hierarchical regression (Vittinghoff et al., 2005) was used to test whether or not operational capabilities acted as moderating variables. Hierarchical regression was chosen for two reasons. First, the firm level of data (n = 433) is nested within the country level of data (US and China), and as such, is treated as an unbalanced panel. Secondly, a two-step testing process is needed to test the hypotheses that examine the moderating effects of operational capabilities.

The first step in the hierarchical regression analysis was to test for main effects, specifically, to test whether the individual dimensions of environmental pressure are predictors of project performance. In step two of the hierarchical regression analysis, tests were conducted to determine if the relationships between environmental pressure and project performance are moderated by operational capabilities. A total of four hierarchical regression models were used to test the study's hypotheses.

Results from the regression analysis indicate that the moderation effects are quite weak. None of the moderation effects are significant at the level of 0.10. Thus, the empirical results do not provide support for the fit as moderation.

6. Discussion

6.1. Overview

This study has explored how the alignment of operational capabilities and environmental pressure affect project performance from both a mediation perspective and a moderation perspective. The paper is innovative because within the context of these variables the mediating and moderating effects of operational capabilities on the relationship between environmental pressure and IT project performance are both examined.

6.2.1. Theoretical and managerial implications

Although prior studies have found that environmental pressure affects IT project performance, our study is the first to examine the mediating and moderating effects of operational capabilities on this relationship. Our results suggest that operational capabilities mediate the relationship between environmental pressure and IT project performance. Our findings also indicate that operational capabilities do not moderate the relationship between environmental pressure and IT project performance.

Overall, findings from our 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 moderating and mediating variables in project management research. Without exploring the mediating and moderating variables in this study, the unique relationships between environmental pressure and operational capabilities would not have been revealed. It is only by exploring the impact of the one or more mediating/moderating variables that the significant relationships reflected in them are observed.

Additionally, from a theoretical perspective our findings indicate that environmental pressure affects 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) on project performance (i.e., Schmidt et al., 2001; Dulaimi et al., 2005; Mullaly, 2006; Liu and Yetton, 2010) by showing how operational capabilities mediate the relationship between environmental pressure and project performance.

From a managerial perspective it appears operational and environmental factors can interact in a manner that impacts project performance. Thus, it is important for managers to be aware that these interactions exist so they can make decisions accordingly. It is also important for project managers to

seriously consider the impact of environmental pressure on specific operational capabilities when designing and carrying out project management practices. For example, the financial resources granted by local governments to road construction contractors for long-term projects have been shown in our 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 of some road projects because of the political environment faced over the long-term (e.g., tax reduction pressure), which in turn could impact project performance.

6.3. Limitations

One methodological limitation of this study involves our use of a cross-sectional design. The rationale for the cross-sectional design is: (1) to examine the effect of operational and environmental factors on project performance across industries and two distinct cultures, rather than in a specific industry, and (2) to obtain a sample size sufficient for analysis. Because the unit of analysis is an organization, the potential sample size is small, possibly as a result of the manner in which the questionnaires were distributed. Unfortunately, a cross-sectional design is limited and does not eliminate all of the external factors in obtaining industry-specific information (Sabherwal and Chan, 2001). Because of this limitation, if it is feasible, future research efforts might consider utilizing a longitudinal research design when examining the impact of operational and environmental factors on project performance.

Another limitation associated with the current study is that all measuring instruments used in this research are based on managers' perceptions. Although this is a time-honored and valid operational process for measuring various constructs (Buchko, 1994), all questionnaire surveys are limited by the truthfulness of the respondents. It should be noted, however, that the validation and reliability analyses

undertaken in this study do provide some level of assurance of the instrument's ability to capture useful measures.

6.4. Conclusions

Overall, the goal of this study was to examine the mediating/moderating 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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Appendix
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

Maturity of IT development process

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
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

Per3 – Projects met expectations.	7 1 2 3 4 5 6
Per4 – Project team members are satisfied to work together.	7 1 2 3 4 5 6
Per5 – Benefits of projects to the organization are high.	7 1 2 3 4 5 6
Per6 – Projects resulted in sales growth.	7 1 2 3 4 5 6
Per7 – Projects helped the organization to increase market share.	7 1 2 3 4

							5
							6
							7
Per8 – Projects helped the organization improve its competitive position.							1
							2
							3
							4
							5
							6
							7