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The Impact of IT on Firm Performance: Mediating Roles of Business Process Management and Supply Chain Management Competence

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Abstract

The aim of the study reported here was to explore the effect of information technology on firm performance through the mediating roles of business process management and supply chain management in companies located in the Shiraz Industrial Estate in Shiraz, Iran. A structured questionnaire was distributed among a sample of 105 managers and other personnel with experience in moderating activities in business processes and supply chain management. A descriptive correlational research design was employed to address the research questions and hypotheses. The data were analyzed using Smart-PLS software as well as structural equation modeling (SEM) and path analysis. Results indicated that IT had no direct significant effect on firm performance. It did, however, achieve a significant indirect positive effect in association with business process management and supply chain management. It was also found that IT influenced business process management and supply chain management positively and significantly. Companies performed better under the influence of business process management and supply chain management.

Key Words: *Information Technology (IT), Business Process Management (BPM), Supply Chain Management (SCM), Firm Performance.*

Introduction

In recent years, firms have been busy investing in applied IT programs as a means of generating new capacity to improve their management. For instant in china, small- and medium-sized businesses put about 200 billion RMB Yuan (approximately US$30 billion) into IT. Yet, contrary to expectations, there has been only minimal improvement in procedures and competitiveness (Peng et al., 2016). This “productivity paradox” within information systems - that is, the contrast between “great progress in information technologies” and insufficient yield from investment in technologies (Brynjolfsson & Hitt, 1996) – remains unresolved.

The processing business via IT would reason that any valuable income comes from the fundamental integration of IT with business activities (Barua et al., 1995). Generally, IT bears on business processes (product development, quality management, production, and supply chain management) which would, in turn, infiltration firm performance (Peng et al., 2016). Lewis and Byrd (2003) suggested a schema to survey the mediating role of business processes between IT and firm performance. They believed that IT provides infrastructure required for business activities and related processes. Recent findings from information systems' researches show that business management plays an important mediating role between IT capacities and firm performance (Mithas et al., 2008, Mithas et al., 2011). Using game theory, Sun et al. (2010), established the necessary conditions for the optimal relationship between the level of IT usage and managerial capacities in order to effectively employ IT in this setting, it was found that IT was incapable of utilizing a firm's resources.

Research on the value of IT businesses in developed countries has reached a certain level of maturity (Constantinides et al., 2012; Grover & Kohli, 2012). In developing countries like Iran, however, such investigations have begun only recently, and it remains unclear whether previous findings are applicable in these settings. It is possible, for example, that differences in level of economic expansion, organizational structure, and culture will affect IT businesses. According to Sun et al. (2010), there has been minimal empirical investigation of the relationship between IT investment and organizational performance in developing countries, and the results of the small number of available studies are often contradictory. Lin et al. (2004), for example, explored the returns from IT investment in China's production industries and found that IT contributed to firm performance. In another study on domestic and foreign electronic companies active in Malaysia, Rasiah and Malakolunthu (2009) showed that more technology would increase productivity. Zhu (2004), however, used data from a Chinese state bank to argue that the results of IT investment are precarious and unclear, and may have a negative impact on the bank's final productivity.

Against this background, the present study utilizes four new paradigms that determine the ways in which IT generates more valuable business for firms in such countries. The first paradigm is the development of an outlook based on IT (Barua et al., 1995; Soh & Markus, 1995). Here, business processes mediate the impact of communication and information technology on firm performance while the mediating role of business process management is emphasized. The second paradigm relates to distinct categorization of capacities within business management as defined in this study: internal business process and supply chain management. The third is the focus of the present study on elucidating the relation among capacities provided by IT on one hand and firm performance on the other. Finally, given the productivity paradox, the present study seeks to develop a precise understanding of the relation between IT and firm performance.

Hypotheses

We explored the impact of IT on firm performance by examining the mediating roles of business process management and supply chain management in Shiraz Industrial Estate in Shiraz, Iran. Nowadays firms are not considered independent, but parts of multi-firm networks, supply chains, delivering stuffs, products and services to final customers and end user consumers (Lambert and Cooper, 2000). Supply chain management literature illustrate that these multi-firm networks can provide significant advantages. The utilization of information technology, which in turn, is considered a crucial requirement for managing these networks, and has been associated with significant supply chain efficiency improvement (white and pearson, 2001).

The capability to effectively manage processes is crucial for organizational survivorship and achievement. Researchers have proposed that IT is a significant enabler of process management capability due to its potency to minimize process variability, enhance process quality, and improve process result (Peng et al., 2016).

IT resources embrace IT infrastructure, human skills in working with IT, and organization's ability to manage IT, which incorporate to form an intangible resource called IT capability (Bharadwaj, 2000). According to Ross et al. (1996), IT capability is the potency to manage these three IT resources. The combination of these resources is a better resource to compete, or better to say, is a competitive advantage. Resource-based view of IT suggests that firms could differentiate themselves from competitors by means of their IT resources (Chen & Tsou, 2012). On the other hand, while it is difficult to acquire or imitate each distinguished IT resources, firms could achieve competitive advantage via learning to combine their existing IT resources effectively (Bharadwaj, 2000).

The investigation adopted a systematic framework appropriate to our purposes. A conceptual model (Figure 1), derived from Peng et al. (2016), was employed to analyze the hypotheses. All research phases were based on this conceptual framework, which defines the variables and their relations. Such a framework allows researchers to develop theories about the relations between factors known to have weight based on their own results or those that may be logically deduced from the findings of previous research.

Every survey or field research needs a mental map or conceptual model in the form of analytic tools, variables, and relations. A review of relevant empirical and theoretical literature generated one such analytic model and associated hypotheses regarding the impact of IT on firm performance via the mediating roles of business process management and supply chain management. The model is depicted in Figure 1.

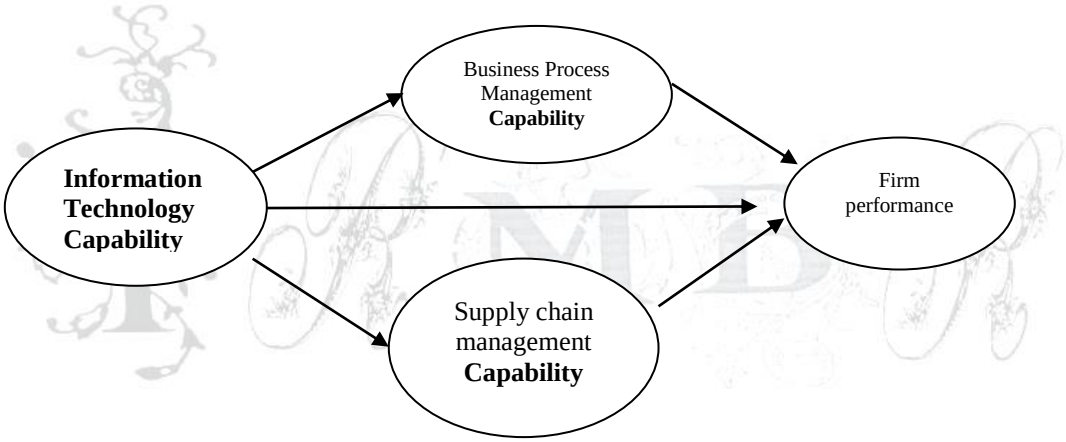

Figure 1: Research conceptual model

Hypothesis 1: IT is capable of significant impact on firm performance.
Hypothesis 2: IT is capable of significant impact on business process management.
Hypothesis 3: IT is capable of significant impact on supply chain management.
Hypothesis 4: Business process management is capable of significant impact on firm performance.
Hypothesis 5: Supply chain management is capable of significant impact on firm performance.
Hypothesis6: IT is capable of significant impact on firm performance due to business process management.
Hypothesis 7: IT is capable of significant impact on firm performance due to supply chain management.

Methodology

Our purpose is to investigate the impact of IT on firm performance. Data were collected from a sample of experts (executives and operation managers) using a questionnaire designed and developed based on that of Peng et al. (2016). The data were analysed to assess the structural model using the methods of structural equation modeling and partial least squares (PLS) path modeling.

Measurement of construct

There are four main constructs in this research including IT capability, supply chain management capability, business process management capability and firm performance. A 5-item scale, developed by Xiao and Xie (2007) was used to measure IT capability. ITC was measured with 5 items including technology advancement, technology scalability, technology security, quality of operation support and management support. A 10-item scale, expanded by Lin et al. (2004) was used to measure supply chain management capability. SCMC items was assessed with concentration on supplier management, supplier evaluation and supplier selection. A 4-item scale, fostered by Peng (2009) was used to measure business process capability. BPMC was assessed with 4 items including professionalism, organizational control, process quality control and customer satisfaction. A 4-item scale progressed by Chan et al. (1997) was used to measure firm performance. FP was measured with 4 item pertaining involving financial performance, market growth, innovation and firm reputation.

Data Collection

The research population included all managers and agents of firms operating in Shiraz Industrial Estate, a total of 157 people. Non-probability convenience sampling was employed to recruit participants. One of the partial least squares model's attributes to test the hypotheses and path analysis is the non-sensitivity to number of sample. There is broad settlement that the smallest sample for a PLS analysis contains the largest number from these two rules (Barclay et al., 1995):

1) The number of research indicators for a given model with the largest number of indicators (representative-item) among research models multiplied by 10. In the present study, supply chain management had the largest indicators, which gives 100 according to this rule.
2) The largest number of relations a given variable has in the structural model of a study (or the largest number of variables that can forestall a given variable directly) multiplied by 10. In the present study, all variables had one relation, which gives 10 according to this rule.

The estimated smallest possible sample, after comparing the outcomes of these two rules, was 100. A total of 120 questionnaires were distributed to account for potential non-responses and incomplete responses. The final sample comprised 105 questionnaires which were subjected to statistical analysis.

Statistical Analysis

This research was applied in type and descriptive-correlational in method. All measurement indicators were assessed for validity and reliability within a measurement model context and common model bias was assessed to ensure that the indicators consistently measured what they were supposed to measure. Descriptive statistics were computed to ensure that the study variables were sufficiently normally distributed. Correlations were computed to establish bivariate relationships among the study variables. The theorised model was then assessed following a structural equation modeling methodology using smart PLS software. This software generates goodness of fit indices that were used to determine how well the theorised model fits the data. The software also generates standardised coefficients that were used to assess support for the study hypotheses.

Results

Indicators Assessment Process

The research questionnaire was assessed for content validity by several experts and professors of business management working in universities. Following some modifications, which were approved by the expert

panel, 30 questionnaires were distributed in the population to assess face validity. A number of questions were not clear. Several were deleted and others were rephrased. The final questionnaire was assessed as having sufficient face validity.

Structural equation modeling (SEM) using partial least squares (PLS) was employed to test the hypotheses and model validity. PLS is based on variance and requires fewer conditions than other techniques such as LISREL or AMOS (Liljander et al., 2009). The main advantage of this technique, however, is that it requires fewer samples (Wixom & Watson, 2001). PLS is very well suited to studies where sample size is limited and where items and variables display varying distribution (Hair et al., 2010). As described below, PLS modeling involves two steps. First, validity, reliability and factor analyses are conducted. Second, the structural model is evaluated through estimation of paths between variables and identification of model fitting indexes (Hulland, 1999).

Testing the assessment models focuses on establishing the validity and reliability of the research tools. The convergent validity of the model was assessed by the Average Variance Extracted (AVE) and Composite Reliability (CR). The results for five research variables are shown in Table 1. CR scores higher than 0.7 and average variance amounts higher than 0.5 are two necessary conditions for construct convergence and correlation reliability (Lin & Huang, 2009). As shown in Table 1, all CR amounts are higher than 0.7 and average variance amounts are higher than 0.5, making convergence validity acceptable.

Table 1: Average Variance for Research Constructs

Variable Standard	**Information Technology Capability (ITC)**	**Business Process Management Capability (BCMC)**	**Supply Chain Management Capability (SCMC)**	**Firm Performance (FP)**
AVE	0/**534**	0/**601**	0/**600**	0/**592**
CR	0/**851**	0/**857**	0/**857**	0/**812**

Divergent validity is measured by the difference between indexes of one construct and those of other constructs in a model. This is achieved by comparing root values of AVE for every construct with the correlation coefficients of the constructs. Table 2 shows the relevant matrix in which the values on the main diagonal represent root values of AVE coefficients for each construct and the values below the main diagonal represent correlation coefficients of each construct with others. The root values of AVE for each construct are larger than the correlation coefficient of that construct, indicating acceptable divergent validity of constructs.

Table 2: Matrix Showing Root AVE Values and Correlation Coefficients of Constructs (Divergent Validity)

	ITC	**BCMC**	**SCMC**	**FP**
ITC	**0/730**			
BCMC	**0/713**	**0/775**		
SCMC	**0/688**	**0/599**	**0/775**	
FP	**0/705**	**0/715**	**0/517**	**0/770**

To test the reliability of the questionnaire we used both Cronbach's alpha (Table 3) and PLS.

Table 3: Cronbach's Alpha Coefficients

Research construct	ITC	BCMC	SCMC	FP
Cronbach's Alpha	0/783	0/**822**	0/**780**	0/791

The latter uses index reliability (Rivard & Huff, 1988). This involves assessing factor loading by finding the correlation values of indexes of a given construct. Values equal to or greater than 0.6 represent acceptable reliability (Hulland, 1999). If the factor loading value of a question and the related feature is less than 0.6, that question can be omitted. As shown in Figure 2 and table 4, all such values are higher than 0.6, indicating considerable correlation.

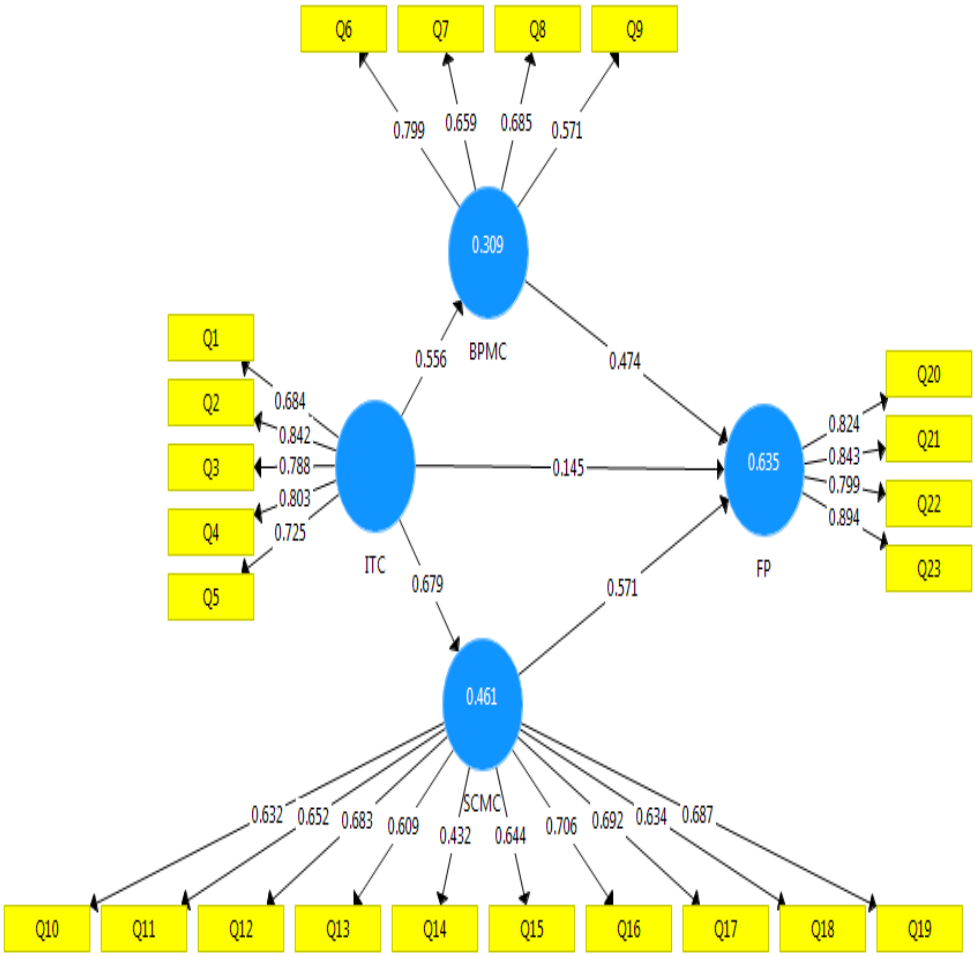

Figure 2: Application output-tested research model (path coefficients and factor loads)

Table 4: sample of measurement items and factor loadings

Loading factor	Items	Variable	Loading factor	Item	Variable
0/648	Technology advancement	**ITC**	0/632	Evaluation system	**SCMC**
0/842	Quality of operation support		0/652	Technical support	
0/788	Technology scalability		0/683	Detailed description	
0/803	Management support		0/609	Product design	
0/725	Technology security		0/432	Product plan	
0/571	professionalism	**BPMC**	0/644	Continuous improvement	
0/659	Organizational control		0/706	Timelines of delivery	
0/799	Process quality control		0/692	Shipping reliability	
0/685	Customer satisfaction		0/634	Product quality	
0/687	Service design				
0/824	Financial performance	**FP**			
0/843	Market growth				
0/799	innovation				
0/894	Firm reputation				

Since items 9 and 14 in both the main and secondary models achieved factor loads lower than 0.6, they were removed and the model was repeated. Figure 3 shows the modified model.

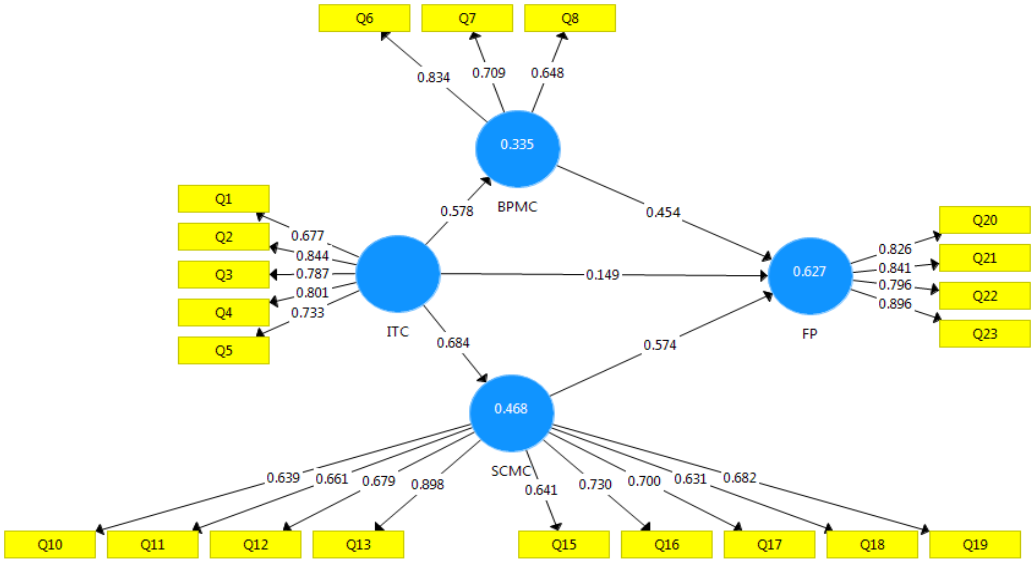

Figure 3: Modified model with estimated standard coefficients

Structural Equation Modeling Results

The second step was to evaluate the structural model by testing the research hypotheses and the effects of latent variables on each other. To test the hypotheses, the bootstrapping technique in Smart PLS was used to show the t coefficients (Figure 4). T-values other than those between -1.96 and +1.96 indicate significance of related parameters and, therefore, of the research hypothesis.

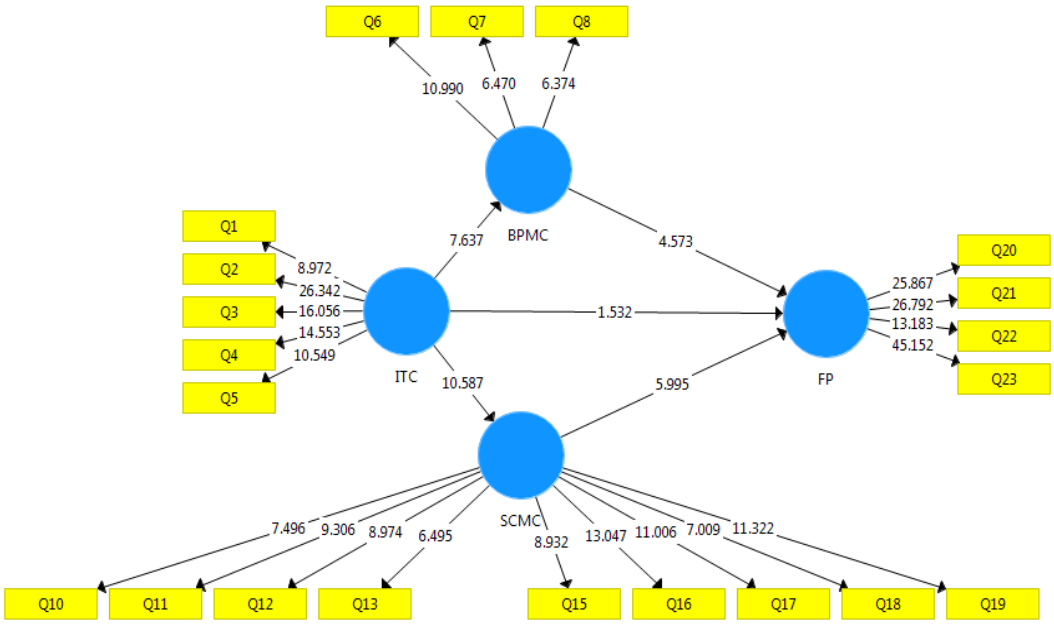

Figure 4: Application output-t values

One method of testing constructive models is R^2 or coefficient of determination. R^2 is a number that indicates the proportion of the variance in the dependent variable that is determined and explained by the independent variable(s). R^2 is zero for independent variables and more than zero for dependent variables. A larger R^2 indicates more dependence. In the present context, IT accounted for 0.335 percent of the variance for business process management and 0.468 percent of the variance for supply chain management. IT, business process management, and supply chain management together accounted for 0.627 percent of the variance for firm performance. Weak, medium and strong R^2 values are conventionally given as 0.19, 0.33, and 0.67, respectively. Hence it can be concluded that our model provides high predictive capability. The remaining amount is accounted for by forecast error as well as other factors that affect business process management, supply chain management, and firm performance.

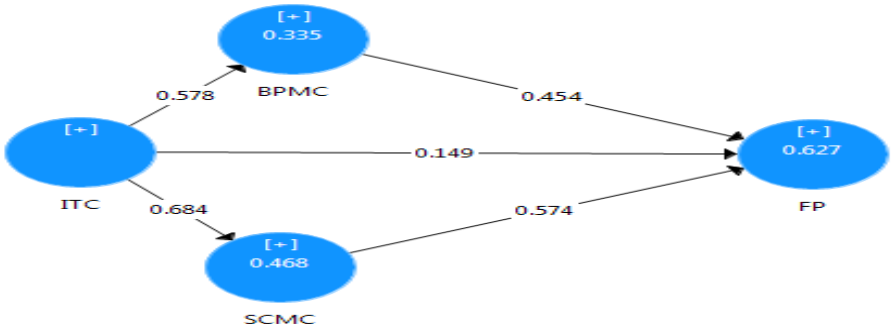

Figure 5: Assessing constructive models

The research hypotheses can now be addressed, as explained below.

Hypothesis 1: IT is capable of significant impact on firm performance.

The path coefficient and t-value tell us that IT has no significant impact on firm performance (t-value lies between -1.96 and +1.96).

Hypothesis 2: IT is capable of significant impact on business management.

The path coefficient and t-value tell us that IT has a significant impact on business process management (t-value does not lie between -1.96 and +1.96). The path coefficient allows us to say that IT has a significant positive impact on business management since this coefficient is positive. Thus, with better IT facilities, business process management improves and, with fewer IT services, business process management worsens.

Hypothesis 3: IT is capable of significant impact on supply chain management.

The path coefficient and t-value tell us that IT has a significant impact on supply chain management (t-value does not lie between -1.96 and +1.96). The path coefficient allows us to say that IT has a significant positive impact on business management since this coefficient is positive. Thus, with better IT facilities, supply chain management improves and, with fewer IT services, supply chain management worsens.

Hypothesis 4: Business process management is capable of significant impact on firm performance.

The path coefficient and t-value tell us that business process management has a significant impact on firm performance (t-value does not lie between -1.96 and +1.96). The path coefficient allows us to say that business process management has a significant positive impact on firm performance since this coefficient is positive. Thus, with better business process management, firm performance improves and, with weak business process management, firm performance worsens.

Hypothesis 5: Supply chain management is capable of significant impact on firm performance.

The path coefficient and t-value tell us that supply chain management has a significant impact on firm performance (t-value does not lie between -1.96 and +1.96). The path coefficient allows us to say that supply chain management has a significant positive impact on firm performance since this coefficient is positive. Thus, with better supply chain management, business process management improves and, with weak supply chain management, firm performance worsens.

Hypothesis 6: IT is capable of significant impact on firm performance due to business process management.

The path coefficient and t-value tell us that IT has a significant positive impact on firm performance due to business process management (t-value does not lie between -1.96 and +1.96). The path coefficient allows us to say that IT has a significant positive impact on firm performance due to business management since this coefficient is positive. Thus, with better IT facilities, business process management improves, therefore the firm performs better. With fewer IT services, business process management worsens and firm performance declines.

Hypothesis 7: IT is capable of significant impact on firm performance due to supply chain management.

The path coefficient and t-value tell us that IT has a significant positive impact on firm performance due to supply chain management (t-value does not lie between -1.96 and +1.96). The path coefficient allows us to say that IT has a significant positive impact on firm performance due to supply chain management since

this coefficient is positive. Thus, with better IT facilities, supply chain management improves, therefore the firm performs better. With fewer IT services, supply chain management worsens and firm performance declines.

Table 5: Direct Impacts, T-Values and Hypotheses

Status	Significance	t-value	Standardized coefficient β	Hypothesis
Rejected	Sig>0.05	1/532	0/149	Firm performance ← IT
Approved	Sig<0.05	7/637	0/578	Business process management ← IT
Approved	Sig<0.05	10/587	0/684	Supply chain management ← IT
Approved	Sig<0.05	4/573	0/454	Firm ← Business process management performance
Approved	Sig<0.05	5/995	0/574	Firm ← Supply chain management performance
Approved	Sig<0.05	7/ 637and 4/573	0/264	IT due to business process management as a firm's performance ←mediator
Approved	Sig<0.05	10/587and 5/995	0/392	IT due to supply chain management as a firm's performance ← mediator

Discussion

The following discussion integrates results from this and previous local and international studies on the ways in which IT, business process management and supply chain management affect firm performance. It makes some practical recommendations for firms located in the Shiraz Industrial Estate and similar enterprises elsewhere.

As noted previously, there have been contradictory findings about the relationship between IT investment and firm performance. Some studies show that such investments enhance performance while others report negative impacts. These apparently paradoxical findings provided the rationale for the present study's focus on the mediating role of business process management and supply chain management in the context of the effect of IT on firm performance. We found that IT had no effect on the firms under investigation. However, when the mediating roles of business process management and supply chain management were examined, IT was shown to have a significant positive impact. In fact, IT was found to enhance business process and supply chain management. These improvements in turn brought about positive change in a firm's performance. Supply chain management was found to have greater impact than business process management. Firms in Shiraz Industrial Estate deployed a number of strategies and indexes that contributed to supply chain management and, hence, to their performance. These included: long term contracts with suppliers; problem solving via green supply chain management with help from customers; reducing the number of suppliers through zero inventory management and total quality management; evaluating suppliers on the bases of quality, delivery and price; developing a comprehensive evaluation system for suppliers; active participation of suppliers in the production process and firm services; securing several reliable suppliers; holding educational programs for suppliers; and providing technical support. Managers also enhanced firm performance through business process management by attending to the following indexes: firm audit and credit in the market; efficacy in solving problems related to business processes; and identifying optimal responses to unexpected events.

Conclusion

Our results have several implications for firm managers at Shiraz Industrial Estate. They suggest the importance of: investing in IT and developing sound IT platforms in firms; maintaining up-to-date IT programs to improve competitive potency; digitizing all firm data and keeping soundly coded information; promoting efficient management in refining and optimizing business activities through information systems; highlighting the strategic significance of IT in the firm's activities; and developing easy-to-use information systems. These indexes can contribute to both business process management and supply chain management and, hence, to firm performance.

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