

**020-0013**

**Reasons for information technology adoption and sophistication within manufacturing**

**SMEs**

**Morteza Ghobakhloo \***

Email: [morteza\\_ghobakhloo@yahoo.com](mailto:morteza_ghobakhloo@yahoo.com)

Telephone: (+34) 958 241586

**Jose Benitez-Amado \***

Email: [joseba@ugr.es](mailto:joseba@ugr.es) (corresponding author)

Telephone: (+34) 958 241586

**Daniel Arias-Aranda \***

Email: [darias@ugr.es](mailto:darias@ugr.es)

Telephone: (+34) 958 242349

\*Department of Management

School of Economics and Business

University of Granada

Campus Universitario de la Cartuja s/n

18011 Granada, Spain

**POMS 22<sup>nd</sup> Annual Conference: Operations management: The enabling link**

**Reno, Nevada, U.S.A.**

**April 29 to May 2, 2011**

## **Abstract**

This paper analyzes which reasons persuade small and medium enterprises (SMEs) to adopt information technology (IT), as well as which factor and how affect the level of IT sophistication in this entrepreneurial segment. Drawing on the technology-organization-environment view of the firm, the study hypothesizes that technological, organizational and environmental factors can be viewed as the reasons for IT sophistication within SMEs. Our proposed research model and hypotheses are tested using survey data from a sample of 121 Iranian manufacturing SMEs. We find that external pressure, information processing needs, IT-enabled innovativeness and performance and competitive pressure are the key drivers of IT sophistication within SMEs. The findings offer valuable insights to executives and consultants that why SMEs move toward IT adoption. Likewise, the results of this study could serve as a benchmarking measure of reasons persuading SMEs to adopt sophisticated IT.

**Keywords:** IT adoption, technology management, OM in emerging economies, OM-information systems link, manufacturing SMEs

## **1. Introduction**

IT adoption is a significant subject matter of study in numerous areas comprising small and medium enterprises (SMEs). In order to describe the process of information technology (IT) adoption, it is essential to identify and categorize factors, drivers, enablers and barriers entangled in IT adoption. Some scholars argue that drivers and barriers might be similar to factors with either positive or negative influences over IT adoption [17, 71]. On the other hand, other scholars [e.g., 28, 44, 53] defined and classified IT drivers, barriers and affecting factors separated in specific categories. They stated that the drivers are the reasons why organizations adopt IT. In

this circumstance, drivers and barriers to IT adoption in organizations can often be the reverse to each other [17]. Therefore, drivers of IT adoption can be defined as a collection of internal and external reasons which force and/or persuade SMEs to move toward implementation of IT solutions.

On the other hand, the rich diversity of perspectives toward drivers that persuade SMEs to adopt IT is available on a huge body of literature. Most of these perspectives have concentrated on the benefits of IT persuading SMEs to adopt IT solutions. Nevertheless, it should be considered that SMEs movement toward IT is also attributable to inter-organizational and intra-organizational drivers, which force them to implement IT. In this research, the term *IT sophistication driver* includes a collection of external and internal reasons that force and/or persuade SMEs to move toward implementing and using sophisticated IT solutions. Thus, this paper aims to answer more clearly and understandably the question why SMEs are incrementally adopting IT and which factors are affecting the level of IT sophistication. Likewise, this study addresses and discusses specific issues attributable to the unique characteristics of SMEs, those issues that differentiate these businesses from their larger counterparts on the subject of reasons for IT sophistication.

## **2. Literature review**

In general, the process of IT adoption in SMEs is different from their larger counterparts. It has been reported that there is significant difference between large organizations and SMEs in benefiting from IT solutions so that; large organizations have profited noticeably more than SMEs in both their improved sale and costs saving [68]. These differences could be attributed to the unique characteristics of SMEs such as limited access to the marketplace, globalization constraint, flexible structure, faster responses to changes and agile decision-making process [e.g.,

78], as well as specific circumstances commonly referred to as a resource (knowledge, skill, financial and managerial) poverty [53, 79]. Consequently, IT adoption by SMEs is considerably different from larger businesses [24, 77].

The dynamism and flexibility of IT in nature has leveraged a vast variety of business activities [30]. New IT has such noble characteristics like capability to generate rapid growth in computing power, communication capacity improvement and innovativeness that persuades every business to adopt these technologies [6, 7, 41, 46, 75]. In SMEs, the decision to implement a new IT can be motivated by a series of factors including necessity for decrease in production and labor costs [39, 53], improved process and organizational flexibility [70], improvement in decision-making efficiency [52], improved customer/supplier satisfaction [14, 43] and discovery of new business opportunities and access to market information [75]. In spite of potential benefits of IT, a number of studies have revealed several unsuccessful IT adoptions in which alongside very slow rate of adoption, IT sometimes does not deliver what is anticipated and/or lots of SMEs do not occasionally recognize what actually is achieved from IT adoption [43, 51, 73, 78]. However, SMEs are incrementally making use of it to pave the way for reaping benefits while various challenges and pitfalls await them when it comes to adopt IT. From the other perspective and apart from perceived benefits of IT persuading SMEs to adopt it, many studies have acknowledged that there are other many factors that contribute to the adoption process and have forced SMEs to adopt IT as necessity for the survival of most companies [13, 20, 67]. There are numerous exogenous characteristics in the business environment and endogenous organizational factors triggering SMEs to adopt IT [2]. However, these features impelling SMEs to use IT may be idiosyncratic to any specific organization [74].

### **3. Hypothesis development and proposed research model**

Within information systems (IS) literature, there is no generally accepted IT adoption definition since various definitions of IT have widely been employed by different researchers. IT might be regarded as the technological aspect of IS [29], which is aimed at the creation of computer-based IS by using computer systems in organizations [71]. IT can be defined as “those technologies engaged in the operation, collection, transport, retrieving, storage, access presentation, and transformation of information in all its forms...” [12]. IT adoption can be defined as applying computer hardware and software solutions such as computer-aided design (CAD), computer-aided manufacturing (CAM), electronic data interchange (EDI), material requirements planning and Internet applications that provide support for operations, management, and decision-making in organizations [75, 78].

On the other hand and drawing from the resource-based theory of the firm, IT can be defined in terms of IT-based resources [6, 65]. Consistent with Barney's [3] resource-based classification, Melville et al. [48] operationalized IT resources as physical capital (e.g., IT infrastructure and specific business applications) and human capital (e.g., technical and managerial knowledge), and organizational capital resources. Likewise, principal IT-based resources can be considered as the advancement of IT tools used in business and the extent to which they are aligned with business functions [85], or IT infrastructure, human IT resources, and IT-enabled intangibles (e.g., customer orientation and knowledge) [9].

In light of aforementioned views, term *IT* will cover wide range of information processing and computer applications in organizations in this study. It will cover firm's IT infrastructure that process or transmit information to enhance the effectiveness of individuals and organizations. Furthermore, term IT includes any computer application and required hardware packages,

CAD/CAM systems, EDI and enterprise resource planning (ERP) which supports business functions of an organizations. For this study, the term *adoption* would be defined as acceptance of any of abovementioned IT, as well as putting that innovation to practice. Thus, using Thong and Yap's [78] and Tan et al. [75] definition, IT adoption is defined as physical utilization of IT in supporting and conducting business.

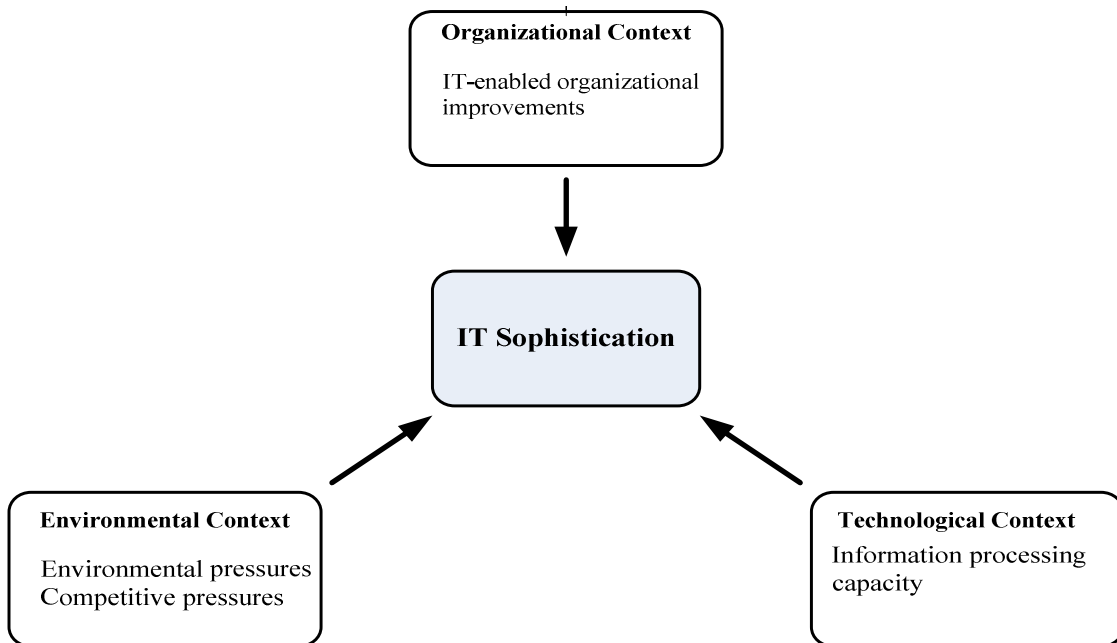
Furthermore, the earliest attempt to define *IT sophistication* can be attributed to the Nolan [54] with his paradigm called *stages of growth* which proposed fundamental concept named *IS maturity*. Afterward, different concepts and criteria of system maturity or sophistication were investigated by a number of researchers [16, 19, 66]. Defining IT sophistication in terms of "construct which refers to the nature, complexity and interdependence of IT usage and management in an organization", Raymond and Pare [66] discuss that IT sophistication comprises three dimensions, namely, extent of IT use, intensity of IT usage and IS integration, which is defined in terms of platform technologies (hardware and operating systems), network and telecommunications technologies, databases, and a variety of shared services, such as EDI, e-mail, universal file access, video conferencing and teleconferencing services [19]. In this paper, this definition of sophistication with some minor adaptations has been taken which includes the number (diversity) of IT tools used (technological sophistication), as well as the extent of IT usage (regarding the time frequency) and integration with daily activities.

### **3.1 Technology-organization-environment (TOE) framework**

Based on the supports provided by prior research [e.g., 23, 56, 81], a perception-based model of IT sophistication in SMEs applying a TOE framework has been developed and demonstrated in Figure 1. The TOE framework identifies three aspects of a firm's contexts that affect the adoption

and implementation of new technological innovations including technological context, organizational context and environmental context [81]. Iacovou et al. [32] and more recently Kuan and Chau [36] developed TOE framework-based models to investigate the reasons for EDI adoption in SMEs and confirmed the usefulness of the TOE framework. However, a more recent study by Pan and Jang [59] suggested that technological and organizational contexts are the most important attributes influencing decision to adopt ERP in the Taiwanese communications industry. In this study, the organizational context refers to IT-enabled organizational improvements, the technological context refers to information processing requirements, and environmental context refers to environmental and competitive pressures. Each of these three contexts is discussed below:

**Figure 1: A perception-based model of IT sophistication in SMEs**



### **3.1.1. Organizational context: IT-enabled organizational improvements**

IS literature has demonstrated that IT may indeed contribute to the enhancement of business value [21]. In the contemporary and turbulent digital business environments in which agility, continual innovation, and frequent and varied competitive action are almost considered as the core elements of strategic thinking, IT play a significant role as digital options generator which enable puissant business infrastructure for executing different periodic and complex competitive activities required to provide opportunities for organizations to possess long-term business gains [57, 70]. Accordingly, IS literature has proposed that it is common for managers to emphasize the strategic importance of IT investments [40].

IT business value which is interpreted as IT-enabled organizational improvements in this research has been considered as multidimensional phenomenon by previous IS scholars [48]. The term *IT-enabled business value* is generally used to refer to the organizational performance effects of IT in terms of firm innovativeness, productivity/efficiency improvement, customer service enhancement, cost reduction, improved information sharing efficiency, and competitive advantage [6, 7, 11, 64, 65].

IT can enhance the efficiency and effectiveness of business processes per se and in an absolute sense (e.g., regarding the cost and/or quality of processes before and after using IT) [65]. It has been argued that organizations decide to adopt IT tools since IT leveraging competence in businesses can develop firms' scope by enhancing knowledge reach and richness, improve firms' flexibility through increased accessibility and availability of knowledge, and accessibility and availability of knowledge by improving communication and increasing information sharing efficiency [60]. Likewise, some scholars perceive IT contribution to the management of knowledge and knowledge management system change as a key source of improved firm



performance within SMEs in studying competitiveness and innovativeness from knowledge management perspective too [8, 38]. IT is a mechanism that enables SMEs to respond to customer requirements efficiently by enabling information to be transmitted. SMEs endeavor to manage the knowledge sharing process and inter-organizational knowledge processes which perform a prominent role in achieving greater firm value [69]. In addition, SMEs make use of IT in order to achieve effective collaboration or simultaneous cooperation and competition through sharing business knowledge with other members of the cluster, knowledge which may be considered to have provided that company with a competitive position [38].

Moreover, prior IS research goes beyond the direct effect of IT resources arguing that it is not generic IT, per se, that impact relative process performance, rather, higher-order process capabilities as the mediators between IT resources and firm performance provide better justification of IT enabled performance gain [7, 10]. IT can indirectly make firms more agile through a group of IT-enabled capabilities (i.e., digital options) in the form of digitized work processes and knowledge systems to enhance firms' capability to sense and respond to environmental change [57]. Higher-order supply chain integration capability was found to be another IT enabled higher-order process capability generating significant and sustainable performance gains [64]. In the context of interface between IT and innovativeness and productivity within businesses, Benitez-Amado et al. [6] found that IT resources lead to a superior firm market performance through the capability of innovation-supportive organizational culture.

With regard to the immense supports of previous literature on the subject of contribution of IT to the enhancement of business value [41], it is plausible to assume that IT sophistication might result in higher performance gain in businesses. Level of IT investment and acceptance

(regarding the usage) affect knowledge management capability and subsequently organizational performance [37]. Lower production cost and lower total operating cost of firms [31], as well as increased business productivity [25] were found to be obtained due to higher IT investment levels. Referring to resource-based theory which presumes that businesses can possess a competitive advantage based on resources that are firm-specific, valuable, rare, imperfectly imitable and not strategically substitutable by other resources [3], and consistent with Tippins and Sohi [80] and Wu et al. [85], we argue that to manage IT as a firm-specific resource and consequently enhance its appropriateness for firm, it has to dash ahead of competitors IT resources. In other words, when advanced IT becomes unique and imperfectly mobile across firms, firms adopting and using these advance IT tools ahead of competitors increases the feasibility of acquisition of exclusive benefits through higher efficiency and performance gains. As a result, top executives having higher managerial understanding of the relative advantage of a unique IT may indeed be more inclined to allocate the managerial, financial, and technological resources necessary to adopt and use IT innovations [56]. Therefore, we propose that:

H1: SMEs with higher intention to gain IT-enabled organizational improvements use more sophisticated IT.

### **3.1.2. Technological context: Information processing capacity improvement**

On the other hand, we believe that another rationale for SMEs to adopt and use more sophisticated IT is to respond to information processing needs, which is defined as the gap between information required and information available [1]. Based on this perspective, new information requirements raised from internal and environmental uncertainty is a major driver of

firm movement toward adoption of sophisticated IT. These uncertainties are attributable to the production methods, supply chains, industry clock speed or the larger competitive scenery [e.g., 50]. SMEs could invest on IT to increase their information processing capacity and their flexibility to effectively tolerating and managing uncertainties and supporting decision-making process mechanism [34] since fitted information processing capabilities of a firm with its information processing requirements can result in improved business strategy and better firm performance [35, 83].

Organizations with higher information processing requirements are the deep adopters of IT innovations [49]. The rationale behind is that in order for effectively responding to mentioned uncertainties, firms should adjust their information processing capabilities with their newly created information needs [83]. According to Tushman and Nadler's [82] information processing requirements paradigm of IT innovation diffusion, firms must face increased uncertainty and subsequently new information processing requirements when environment becomes more unstable, interdependency of inter-organizational tasks become more complex and when these task become less routine. Developing Tushman and Nadler's [82] paradigm, Melville and Ramirez [49] suggest that process complexity, clock speed and supply chain complexity are major industrial-level sources of information processing requirements while, IT-based production control and e-supply chain management are two basic information processing capabilities in firms.

To sum up, it could be concluded that information processing has provided a substitute justification for IT adoption in SMEs. In high dynamic and recent turbulent environment, IT plays a significant role as a major enabler of information processing capacity to process increased volume of information needs. Thus, we propose that:

H2: SMEs with greater information processing requirements use more sophisticated IT.

### **3.1.3. Environmental context: Environmental pressure and competitive pressure**

#### **3.1.3.1. Environmental pressure**

From the other perspective, some scholars argue that movement toward IT could be a response or reaction to an event or this change has its origin in the pressure from customers and an emphasis on improving efficiency, as well as pressure from the internal and external environment [e.g., 60]. A study by Iacovou et al. [32] using TOE framework to study reasons for IT adoption within British SMEs discusses that external pressure exerted by trading partners was the main determinant of IT adoption within these firms. In SMEs, it has been largely demonstrated that delivering higher level of customer service and better communication with distant partners/customers are some of the major determinants of IT adoption [e.g., 13, 67]. From a similar perspective, Mehrtens et al. [47] discuss that issue of credibility has risen as a significant motivator for adopting IT tools within SMEs. They argue that this credibility could be achieved through fulfilling customers and suppliers' pressure and significantly their expectation of receiving better services as well. We believe that possible rationale for businesses to pressure their trading partners to adopt and use more sophisticated IT is to guarantee the success of e-business. Empirical evidence suggests that successful e-business is highly dependent upon trading partners' readiness to jointly adopt and use IT tools (e.g., EDI), as well as higher level of IT usage [5, 56, 88]. Hence, it is hypothesized that:

H3a: SMEs undergoing greater external pressure use more sophisticated IT.

### **3.1.3.2. Competitive pressure**

In addition to pressure from distant trading partners driving business to use IT, drivers for IT adoption in SMEs could be also attributed to the firms' desire and need to be competitive as a necessity for their survival [56]. Referring to the dynamism of recent competitive business environment in which dynamic capabilities are crucial for the survival of businesses [4], IT plays a significant role as the facilitator of higher order dynamic capabilities [6, 45]. Thus, it seems rational to believe that the competitive pressure impacts the adoption of novel IT when SMEs perceive that IT resources may strengthen their competitive position and assist them to achieve superior firm performance [e.g., 62]. It has been suggested that by using advanced IT, SMEs may indeed be able to change the rules of competition, alter the industry structure, and leverage new strategies to stand ahead of their competitors, altering the competitive landscape consequently [56, 85]. Competitive pressure is defined here as the extent to which firms perceive themselves threatened by their counterparts within their industry or substitute sector. Lin [42] suggests that competitive pressure (i.e., the pressure resulting from a threat of losing competitiveness) is a determinant of the implementation of IT strategies in organizations. IT adoption could bring about more effective SMEs both internally and externally, so SMEs consider IT as an essential tool with the purpose of competing for both the organizational adaptation and the environmental changes. Furthermore, IT heightens SMEs survival rate where they are functioning in a competitive environment with higher rate of failure risk [39]. As such, SMEs active in industries having high rate of innovation and intense competitive challenge are probable to perceive IT tools as a stronger driver for strategic change than those in other types of industries [e.g., 63]. Hence, it is hypothesized that:

H3b: SMEs undergoing greater competitive pressure use more sophisticated IT.

### **3.2. Control variable**

Prior IS research has found evidence showing that firm size is a significant determinant of IT adoption in SMEs [e.g., 56, 59]. Consequently, firm size was introduced as a control variable in our proposed research model.

## **4. Methodology**

### **4.1. Sampling**

The sampling frame of this research includes all manufacturing SMEs located in the main industrial areas of Semnan province, Iran. This province covers an area of 96,816 square kilometres and is one of the 30 provinces of Iran, which is located in the north of the country and is regarded as one of the biggest industrial regions in Iran. The list of SMEs was obtained from the website of the Semnan Administration of Industries and Mines (<http://www.imo-semnan.ir/>), as well as by collaboration of authorities from both this Administration and Semnan Province Industrial Cities Administration.

In SMEs, IT adoption process is directly affected by top management where in most cases, owner, chief information officer (CIO) and chief executive officer (CEO) are one and the same person. In these firms, the role of CEO is central since their decision influence all firms' activities, both in current and in future. This also refers to IT adoption decision from planning stage to implementation, maintaining, and system upgrade stages [26]. Moreover, regarding the specific computing environment of SMEs in which in most cases, there is no IT department, CEO also becomes the specialist in various facet of IS, although not appropriately trained or adept in IS roles [58]. Hence, CEOs (owners or executives) of the manufacturing SMEs were targeted as the key respondents of this research since they own or oversee the entire operations of

their business and are responsible and decision maker for all stages of IT adoption. With regard to this fact, a structured questionnaire was developed based on the initial feedback received from a pilot questionnaire from CEOs of SMEs. Moreover, to increase the response rate and avoid data missing in the study, questions of personal administrative questionnaire were asked from CEOs through interviews instead of sending questionnaire to them for collecting data. Through the cooperation of Semnan Administration of Industries and Mines and Semnan Province Industrial Cities Administration, the respondents were first contacted by different ways such as telephone or participation in briefings on nature of the study. From 465 qualified SMEs for participation in this study, 124 CEOs agreed to participate in the survey. Finally 121 questionnaires were filled by interview with CEOs of SMEs. The questionnaire was piloted on 30 CEOs of the SMEs in the different industrial areas in Semnan province with the purpose of testing and assuring content validity of the questionnaire. As a result, some minor revisions were applied to the questionnaire before final data collection.

#### **4.2. Definition of SME in Iran**

Nowadays, according to the Iran Small Industries and Industrial Park Organization statement [33], small enterprise is defined by a number of employees and it refers to firm with fewer than 50 employees. In accordance with this statement, 92.2% of Iranian firms have fewer than 50 employees, consequently are categorized as small enterprise. Therefore, small firms will be defined on the basis of the number of employees, limited to upper limit of 50 employees. On the other hand and with respect to the deficiency in the precise definition of medium-sized enterprise in Iran and with reference to European Union government description on medium-sized

enterprise, in this research, medium-sized enterprise refers to enterprise by the greatest extent of 250 annual employees.

### 4.3. Empirical analysis

In this study, constructs of questionnaire and their corresponding measures for suggested model of IT sophistication within Iranian SMEs have been developed on the foundation of validated items from prior research, which are shown in Table 1. The dependent variable, which is known as the level of IT sophistication, was measured using three items from validated scales adapted to the context of this paper, which measure the type and level of usage of 22 different IT tools, as well as IT usage behavior by CEO. These questions are interpreted as level of IT sophistication in surveyed SMEs, which question the frequency of usage of 22 IT tools (extent to which firms have used and are entangled with adopted IT in their daily activities), as well as how frequently these 22 tools are used. In addition, all variable questioning the reasons for adopting IT, which were derived from the literature are interval-scaled. These four independent variables were asked by a set of 14 questions, applying a seven-point Likert ranging from 1 = Strongly disagree to 7 = Strongly agree. Likewise, five general questions about the characteristics of firm (e.g. number of employees) were also required to be answered by respondents.

**Table 1: Measurement items of the study**

<b>Variable</b>	<b>Number of items</b>	<b>References</b>
IT sophistication (dependent variable)	3	[18, 78]
IT-enabled organizational improvements (ITEOI)	5	[63]
Information processing capacity improvements (IPCI)	3	[78]
External pressure (EP)	3	[63]
Competitive pressure (CP)	3	[63, 78]



Regarding internal consistency reliability as the most prevalently employed psychometric measure evaluating survey instruments and scales [75], high internal consistency reliability in the measurement of constructs used in this study has been provided since all the variables possess Cronbach's  $\alpha$  values of more than 0.70 (see Table 2), which exceeds the minimum standard recommended by [55].

**Table 2: Coefficient  $\alpha$  values of all the variables**

<b>Variables</b>	<b>Cronbach's <math>\alpha</math></b>
IT sophistication (dependent variable)	0.8030
IT-enabled organizational improvements	0.7921
Information processing capacity improvements	0.8175
External pressure	0.8777
Competitive pressure	0.7150

In order to ensure proper construct validity, factor analyses were performed on the questions. As a result of performing this analysis (based on principal component analysis and using varimax rotation method with Kaiser normalization), four factor measuring drivers for IT sophistication in SMEs with eigenvalues of 1.00 or higher were extracted. Kaiser's overall measure of sampling adequacy was 0.7875 indicating that these data were appropriate for factor analysis [72]. Moreover, the results explain 68.67% of the all independent variables, showing an acceptable and satisfactory level of construct validity.

#### **4.4. Demographics and descriptive findings**

The questionnaire-based survey of this study for data collection was conducted from mid-May 2009 to mid-July 2009. From 124 questionnaire responded by CEOs of SMEs, 121 (i.e., 97%) were valid. All SMEs surveyed in this research are categorized as manufacturing firms. Table 3 describes the demographic information of sample. In addition, Table 4 provides the description

of other characteristics of sample including information about business sector, firm size, and frequency of suppliers of automotive industries. Here, it should be noted that most of SMEs (23.1%) participated in this study belong to automotive sector which means that these SMEs are producer of automobile parts. Table 5 shows the types of IT tools, which are being used by Iranian SMEs, as well as level of usage (frequency) of these tools in this business segment.

**Table 3: Demographic information of sample**

<b>Measure</b>	<b>Items</b>	<b>Frequency</b>	<b>Percent</b>
Gender	Male	102	84.3
	Female	19	15.7
Age	20-30	6	5
	30-40	34	28.1
	40-50	42	34.7
	50 and above	39	32.2
Education	Diploma	10	8.3
	Associate's degree	22	18.2
	Bachelor	56	46.3
	Master	22	18.2
	Ph.D.	11	9.1
Job title	CEO (owner)	50	41.3
	CEO (stakeholder)	31	25.6
	CEO (executive)	40	33.1

**Table 4: Descriptive and organizational findings of sample**

Variable		Frequency	Percent
Business sector	Automotive parts	28	23.1
	Chemical	18	14.9
	Food and beverage	16	13.2
	Wood/tissue/paper products	12	9.9
	Metal	10	8.3
	Construction products	9	7.4
	Agriculture products	8	6.6
	Oil and related products	7	5.8
	Electronic parts	7	5.8
	Rubber	6	5.0
Supplying automotive industries	Suppliers of automotive industries	48	39.7
	Non-supplier	73	60.3
Number of employees	50 or less	84	69.4
	50-100	22	18.2
	100-150	6	5
	150-200	4	3.3
	200-250	5	4.1

**Table 5: Level of IT usage and usage frequency by surveyed Iranian manufacturing SMEs**

Types of IT tools	Level of usage among Iranian SMEs (%)	Frequency of usage by SMEs using certain IT tools
Accounting/finance software	100	Quite frequently
Electronic staff input/output control system	93.39	Extremely frequently
Artificial intelligence/ expert systems	90.91	Frequently
CAD	77.69	Slightly frequently
Internet	76.86	Quite frequently
Electronic bar coding systems	54.4	Slightly frequently
Word processing	51.24	Quite frequently
ERP applications	50.41	Slightly frequently
Pick and place robots/other robots	43.8	Slightly infrequently
Inventory management software	35.54	Slightly infrequently
Corporate website	35.54	Neutral
EDI	34.71	Slightly frequently
Computerized maintenance management software	28.1	Neutral
Materials requirements planning	21.49	Slightly frequently
E-mail	11.57	Quite infrequently
Manufacturing resource planning	5.79	Slightly infrequently
Production control/planning software	4.96	Quite infrequently
Sales/marketing software	1.65	Extremely frequently
Simulation software/systems	0.83	Neutral
Transportation management systems	0	N/A
Quality control/quality assurance	0	N/A
Local area network	0	N/A

## 5. Hypothesis testing

To test the hypothesis of study and with the goal of determining the contribution of each independent variable entered in the equation in relation to the dependent variable, multiple regressions analysis have been used. Table 6 reveals that once the effect of firm size is controlled, IT-enabled organizational improvements, external pressure, information processing needs, and competitive pressure have a significant positive relationship with level of IT sophistication. The coefficient of determination ( $R^2$ ) value shows that 75.7 percent of the variance associated with level of IT sophistication is explained from the independent variables included in our research.

**Table 6: Multiple regression results between sophistication drivers and level of IT sophistication**

Variable	B	Standard error	Standardized coefficients	t-value	Sig.	Tolerance	Variance inflation factor (VIF)
			Beta				
IT-enabled organizational improvements	0.915	0.349	0.160	2.620	0.010	0.566	1.776
Information processing capacity improvements	1.420	0.255	0.304	5.562	0.000	0.709	1.411
External pressure	1.547	0.218	0.374	7.133	0.000	0.765	1.305
Competitive pressure	0.450	0.220	0.097	2.083	0.039	0.974	1.027
Firm size (control variable)	3.178	0.483	0.340	6.585	0.000	0.790	1.266

Notes: F = 71.373, Sig. F change = 0.000,  $R^2$  = 0.757, Durbin-Watson = 1.985

Thus, all hypotheses in this research are supported. Within the drivers forcing and/or persuading SMEs to use more sophisticated IT, external pressure appears to be the most important variable that positively affects level of IT sophistication in Iranian SMEs. Information processing capacity improvements, IT-enabled organizational improvements, and competitive pressure are respectively other important variables that positively affect the level of IT sophistication.

Furthermore, the result of the VIF analysis (see Table 6) demonstrates that the VIF values for all the variables range from 1.027 to 1.776. These results show that the four independent variables selected for measuring dependent variables in this study do not exceed the levels, which are indication of multicollinearity [e.g., 61]. Petter et al. [61] recommend a general cut-off value of 3.3 for identifying suspect items. The results indicated all VIF scores were below the suggested cut-off point, indicating that no multicollinearity problems exist with the variables. Consequently, variables do not pose a problem to regression analysis in this study [15]. Likewise, Durbin-Watson value of 1.985 for drivers of IT sophistication which is between 1.5 and 2.5, demonstrates that there is no auto correlation problem in the data used in this study [27].

## **6. Discussion**

In the light of factors affecting level of IT sophistication within Iranian SMEs, respondents appeared to be somewhat indifferent in their responses toward the questions measuring independent variables. The rationale behind is that perceptions and answer of CEOs toward these questions are significantly influenced by firms' characteristics such as firm's size and/or business type. As it has been shown in Table 6, external pressure was found to be the most important factor positively affecting level of IT sophistication, followed by information processing capacity improvements, IT-enabled organizational improvements, and competitive pressure. To state the matter differently, it could be explained that the stronger presence of these reasons will result in higher level of IT sophistication. The results of this study on the subject of the level of IT sophistication in SMEs are considerably in accordance with prior IS literature. The level of IT sophistication is significantly affected by level of external pressure on firm for having IT. This external pressure could be imposed by government, customers, suppliers and larger counterpart

[13, 32, 63]. In the context of this study, a particular measure has been used to assess the external pressure on SMEs for adopting IT with regard to specific characteristics of economic and business environment surrounding Iranian SMEs. These external pressure and specific issues have been defined as:

[1] Necessity for having IT applications (e.g., soft process technologies and inventory management software) which are somehow required for fulfilling ISO requirements. It is interesting to note that 61.2% of respondents in this study agreed that fulfilling ISO requirements have forced them to adopt IT since most of them are obliged to have these kinds of standards.

[2] Necessity for having IT applications, those are somehow necessary for fulfilling and achieving specific standards necessitated by government and/or customers and suppliers in the supply networks. 66.1% of CEOs participating in this study have stated that requirements for achieving these standards have forced their businesses to implement IT. As an example of these specific IT applications, EDI can be analyzed. 39.7% of SMEs investigated in this study were found to be suppliers of Iran's automotive industries. Therefore, using EDI is compulsory for these SMEs since according to certain standards necessitated by Iran's automotive industries, their suppliers in the supply networks are persuaded to communicate and interchange data merely through Internet and their websites.

[3] Necessity for employing IT for delivering better services to customers, suppliers and larger counterparts, as well as to better and more secure communication and data interchange.

Furthermore, Iranian SMEs having greater information requirements were found to use more sophisticated IT to improve their information processing capability. This finding supports the study of Karimi et al. [34] suggesting that firms should heavily invest on IT to effectively manage uncertainties and decision-making process through enhanced information processing

capacity. The finding is also consistent with a study by Melville and Ramirez [49] who demonstrated that higher information processing requirements leads to higher extent of IT innovation diffusion in industries. In the light of the information processing theory, we argue that firms are investing on advanced IT to effectively and stably respond to information challenges (created by internal and environmental uncertainty attributable to for instance, the production methods) through improvement of a firm's information processing capability [50].

In addition, IT-enabled organizational improvements were also found to be significant determinant of level of IT sophistication, which is defined as improvement of staffs' innovativeness and productivity, effectively response to inter-organizational change, development of information sharing capability and effective management of inter-organizational knowledge processes. The finding suggests that Iranian SMEs having higher intention to gain organizational improvements use more sophisticated IT. This result supports findings of prior research suggesting that IT can be resulted in creation of innovation in SMEs by providing better access to both internal and external knowledge, as well as generating new knowledge pertaining to staffs' creativity [e.g., 7]. Using IT, organizations can enhance their process innovation through strengthening their IS competencies for example in knowledge management [76], as well as technical innovation by standardization of product and process or the integration within firms and business partners [22]. IT resources enabling firms to improve their competence to support innovative environment (which supply creativity), can be utilized by employees to develop their tasks in a more innovative way [7].

IT could also improve firm's information processing capability which is required to effectively responding to changes SMEs undergoing [50]. In addition, our results support IT-enabled organizational capabilities perspective in which Overby et al. [57] discuss that IT play a

significant role in success of firms by making them agile in sensing and responding to environmental changes and creating digital options. IT-enabled supply chain integration is another IT-enabled capability that results in the creation of firm performance, so that by developing the capability of supply chain process integration and subsequently by sharing information with supply chain partners and creating superior demand planning, sustained firm performance will be created [64]. As such, Benitez-Amado et al. [6] found that by investing on technological IT and managerial IT resources, firms can gain performance through development of an intrapreneurship culture. These authors discuss that IT-enabled intrapreneurship is a crucial capability through which IT-based resources bring about enhancement of firm's market performance. Moreover, in addition to the enabling role of IT on higher-order process capabilities including agility, entrepreneurial alertness, and digital options, IT also improves firm performance through organizational strategic processes such as entrepreneurial action, those organizational capabilities and strategic processes that enable firms to perform different competitive actions [70].

The results of this study also suggest that greater competitive pressure will result in higher levels of IT sophistication in SMEs. This finding supports previous studies suggesting that competitive pressure is significant determinant of IT adoption within SMEs [e.g., 42, 56, 63]. Pressure resulting from competitiveness of environment is a strong rivalry that forces firms to be innovative [78]. Since IT has become technologically feasible and socially acceptable due to contemporary digital revolution, employing this technology by firms has become strategically necessary [62]. Thus, the development of unique and advance IT resources can make firms competitive in this hypercompetitive business environment [84].



On the other hand, on the subject of relationship between organizational characteristics and level of IT sophistication, our results imply that firm size is the significant determinant of IT sophistication within SMEs. This result provides support for the prior literature showing that firm size is the significant determinant of IT adoption even within SME category [7, 63].

## **7. Conclusion**

### **7.1. Contributions to operations management and IS literatures**

Using empirical survey data of manufacturing SMEs, this study examines the drivers within the TOE framework that influence the level of IT sophistication within Iranian SMEs. We found that external pressure, information processing capacity improvements, IT-enabled organizational improvements, and competitive pressure are the main reasons of IT sophistication within SMEs so that more significant presences of these drivers result in higher level of IT sophistication. This research goes beyond economic-rationalistic models to explain innovation diffusion in organizations and incorporate information processing and IT-enabled organizational capabilities perspectives to investigate the reasons for IT sophistication. Furthermore, this study reveals that besides IT-enabled benefits (e.g., innovativeness and competitiveness) persuading SMEs to adopt IT which may goes beyond their strategic necessity, SMEs are forced to use more sophisticated IT due to pressure (i.e., external pressure from customers or suppliers and competitive pressure). We believe that the suggested model makes a unique contribution to research and practice by developing a TOE framework-based model for future research through combining empirical findings and theoretical explanations from the IS literature that provides a clearer understanding of reasons of IT adoption and sophistication in SMEs. Finally, to the best of our knowledge, this is the first study that shows theoretically and empirically why SMEs, in

particular in developing countries invest on and use advanced IT tools. Rationalizing higher level of IT investment and usage from resource based theory of the firm, our study suggests that similar to large organizations, SMEs need to control sophisticated and rare IT resources to satisfy their information requirements, outperform their competitors and to enhance their firm performance.

## **7.2. Limitations and future research directions**

Our results must be interpreted in the light of the study's limitations. First, although this study investigates factors affecting levels of IT sophistication in SMEs, it cannot determine whether the higher levels of IT sophistication increases productivity of SMEs. Second, the research model of this study was explored in several Iranian manufacturing industries. While it is true that this improves the generalizability of the study, biases that might be introduced across industries could be of some concern. Finally, the research uses data provided by only one key informant per firm which were CEOs of surveyed SMEs. However this is currently considered as the standard methodology in management science research, but may suffer from certain drawbacks. While we tried to correct these drawbacks through considering various indicators of the high competency of each key informant, as well as conducting data collection through meeting the respondents and using interviews instead of mailing/e-mailing questionnaire to them, it would have been preferable to use two informants per firm.

The findings of this study can serve as a benchmark measure of reasons forcing and persuading SMEs to adopt IT, as well as determinants of level of IT sophistication for future scholars in which, the same population of SMEs, or others, at different industry section, country and times in the future can be examined. In addition, this study can be extended in several directions. First,

future studies need to investigate the relationship between level of IT sophistication and enhanced firm performance. Second, the role of organizational characteristics including firm resources (i.e., financial, knowledge, and IT experts), firm maturity and organizational capabilities need to be investigated in terms of their impact on level of IT sophistication. Third, regarding the role of individual factors on IT sophistication, which is not generally considered in TOE framework-based research, future studies also need to analyze the social influence (i.e., subjective norm and voluntariness) on IT sophistication since these influences were found to be the significant determinant of IT adoption in organizations [e.g., 86]. Similarly, due to the well substantiated significance of cultural differences between the developed and developing countries in prior IS researches [87], subsequent studies might analyze if and how cultural factors affect and differentiate IT sophistication in developed and developing countries.

### **7.3. Implications for executives**

Based on the results of our study, it can be suggested that IT executives of SMEs could support their strategic position in highly competitive and information intensive environment with high level of external pressure through higher investments in IT. These research findings have several managerial implications. This study highlights the importance of leveraging more complex IT in different SMEs' competitive actions. Since the price of IT have been considerably decreased and they are almost affordable for all SMEs, investing in IT with the aim of only improving daily firm's activities and without integrating with the firm's competitive actions and infrastructure of human and business complementary resources, IT-based competitive advantages are typically accidental rather than planned. Adopting sophisticated IT ahead of their competitors may increase the possibility that businesses receive differential benefits since advanced IT which are

unique and imperfectly mobile across firms can provide them higher efficiency ahead of competitors, the benefits that would not be available to late adopters. Moreover, it can be suggested that IT sophistication can help SMEs with building stronger relationship with their trading partners through enhancement of the quality, quantity, and the speed in which information transfer, availability and timeliness of relevant and important information vital to the business, creation of innovation/creativity-supportive environment, and supplying SMEs with the ability to respond to market changes and customer requests in a timely manner through enhanced information sharing. Similarly, in justifying IT sophistication, CEOs of SMEs are advised to note that higher levels of information processing requirements resulted from insatiability of environment (due to for instance, industry clock speed) can be appropriately satisfied through investment on and intense usage of advanced IT.

The results obtained in this research suggest that despite Iranian SMEs are moving toward adoption and usage of more complex IT to enhance their performance through the development of innovation/creativity-supportive environment, developing firm's human capitals, and information processing capacity development (rather than just gaining typical IT benefits), these businesses are primarily forced to move toward IT sophistication due to pressures exerted from their trading partners, competitors and even the government. Thus, both business and IT executives of SMEs should be aware of the fact that although deployment of highly sophisticated IT may not be necessarily instrumental and justified for their firms, entering to highly competitive business environment will push or force them to adopt sophisticated IT. Moreover, since SMEs, in particular, Iranian SMEs are generally not aware of potential and long-term benefits of advanced IT for their businesses and IT adoption in this sector is usually because of external pressure and imitation of larger counterparts, they need to consider what predictable

impacts could be imposed by adopting and sophisticating IT on their business situations, customers, suppliers, competitive position as well as their competitors. It is imperative that SMEs should precisely evaluate their capability to reap benefits from IT adoption and do not underestimate it. They should be aware that IT is capable of acting as a strategic tool to assist them to compete with their larger counterpart in the globalized market [75].

## References

- [1] Anandarajan, M., & Arinze, B. “Matching client/server processing architectures with information processing requirements: A contingency study”, *Information & Management* (34:5), 1998, 265-274.
- [2] Andries, P., & Debackere, K. “Adaptation in new technology-based ventures: Insights at the company level”, *International Journal of Management Reviews* (8:2), 2006, 91-112.
- [3] Barney, J.B., “Firm resources and sustained competitive advantage”, *Journal of Management* (17:1), 1991, 99-120.
- [4] Barrales-Molina, V., Benitez-Amado, J., & Perez-Arostegui, M.N. “Managerial perceptions of the competitive environment and dynamic capabilities generation”, *Industrial Management & Data Systems* (110:9), 2010, 1355-1384.
- [5] Barua, A., Konana, P., Whinston, A.B., & Yin, F., “Assessing Internet enabled business value: An exploratory investigation”, *MIS Quarterly* (28:4), 2004, 585-620.
- [6] Benitez-Amado, J., Llorens-Montes, F.J., & Perez-Arostegui, M.N. “Information technology-enabled intrapreneurship culture and firm performance”, *Industrial Management & Data Systems* (110:4), 2010, 550-566.

- [7] Benitez-Amado, J., Perez-Arostegui, M.N., & Tamayo-Torres, J. “Information technology-enabled innovativeness and green capabilities”, *Journal of Computer Information Systems* (51:2), 2010, 87-96.
- [8] Bhagwat, R., & Sharma, M.K. “Information system architecture: A framework for a cluster of small and medium-sized enterprises (SMEs)”, *Production Planning and Control* (18:4), 2007, 283-296.
- [9] Bharadwaj, A.S., “A resource-based perspective on information technology capability and firm performance: An empirical investigation”, *MIS Quarterly* (24:1), 2000, 169-196.
- [10] Bharadwaj, S., Bharadwaj, A.S., & Bendoly, E. “The performance effects of complementarities between information systems, marketing, manufacturing, and supply chain processes”, *Information Systems Research* (18:4), 2007, 437-453.
- [11] Bhatt, G.D., & Grover, V. “Types of information technology capabilities and their role in competitive advantage: An empirical study”, *Journal of Management Information Systems* (22:2), 2005, 253-277.
- [12] Boar, B.H. *Strategic thinking for information technology: How to build the IT organization for the information age*, John Wiley & Sons, Inc. New York, NY, U.S.A., 1997.
- [13] Caldeira, M.M., & Ward, J.M. “Using resource-based theory to interpret the successful adoption and use of information systems and technology in manufacturing small and medium-sized enterprises”, *European Journal of Information Systems* (12:2), 2003, 127-141.

- [14] Chang, H.H., & Wong, K.H. "Adoption of e-procurement and participation of e-marketplace on firm performance: Trust as a moderator", *Information & Management* (47:5-6), 2010, 262-270.
- [15] Chatterjee, S., & Hadi, A.S. *Regression analysis by example*, John Wiley and Sons, New York, NY, U.S.A., 2006.
- [16] Cheney, P.H., & Dickson, G.W. "Organizational characteristics and information systems: An exploratory investigation", *Academy of Management Journal* (25:1), 1982, 170-184.
- [17] Cripps, H., Salo, J., & Standing, C. "Enablers and impediments to IT adoption in business relationships: Evidence from Australia and Finland", *Journal of Systems and Information Technology* (11:2), 2009, 185-200.
- [18] Davis, F.D. "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *MIS Quarterly* (13:3), 1989, 319-339.
- [19] De Burca, S., Fynes, B., & Brannick, T. "The moderating effects of information technology sophistication on services practice and performance", *International Journal of Operations and Production Management* (26:11), 2006, 1240-1254.
- [20] De Burca, S., Fynes, B., & Marshall, D. "Strategic technology adoption: Extending ERP across the supply chain", *The Journal of Enterprise Information Management* (18:4), 2005, 427-440.
- [21] Devaraj, S., & Kohli, R. "Performance impacts of information technology: Is actual usage the missing link?" *Management Science* (49:3), 2003, 273-289.
- [22] Dierckx, M.A.F., & Stroeken, J.H.M. "Information technology and innovation in small and medium-sized enterprises", *Technological Forecasting and Social Change* (60:2), 1999, 149-166.

- [23] Downs Jr., G.W., & Mohr, L.B. "Conceptual issues in the study of innovation", *Administrative Science Quarterly* (21:4), 1976, 700-714.
- [24] Fink, D. "Guidelines for the successful adoption of information technology in small and medium enterprises", *International Journal of Information Management* (18:4), 1998, 243-253.
- [25] Francalanci, C., & Morabito, V. "IS integration and business performance: The mediation effect of organizational absorptive capacity in SMEs", *Journal of Information Technology* (23:4), 2008, 297-312.
- [26] Fuller, T., & Lewis, J. "Relationships mean everything': A typology of small-business relationship strategies in a reflexive context", *British Journal of Management* (13:4), 2002, 317-336.
- [27] Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., & Tatham, R.L. *Multivariate data analysis* (6<sup>th</sup> ed.), Prentice Hall, Upper Saddle River, NJ, U.S.A., 2006.
- [28] He, M., & Chen, J. "The drivers for information technology application in supply chain management: How developing countries' companies facing globalization", *Proceedings of the 3<sup>rd</sup> IEEE Conference on Industrial Electronics and Applications, ICIEA*, Singapore, 2008, 2306-2311.
- [29] Hollander, A., Denna, E., & Cherrington, J.O. *Accounting, information technology, and business solutions*, McGraw-Hill Higher Education, Chicago, IL, U.S.A., 1999.
- [30] Howell, J., & Wei, J. "Value increasing model in commercial e-banking", *Journal of Computer Information Systems* (51:1), 2010, 72-81.



- [31] Hu, Q., & Quan, J. "Evaluating the impact of IT investments on productivity: A causal analysis at industry level", *International Journal of Information Management* (25:1), 2005, 39-53.
- [32] Iacovou, C.L., Benbasat, I., & Dexter, A.S. "Electronic data interchange and small organizations: Adoption and impact of technology", *MIS Quarterly* (19:4), 1995, 465-485.
- [33] Iran Small Industries and Industrial Parks Organization, *Iran industries statistics*, 2008, available at <http://www.iraniec.ir/Site.aspx?ParTree=131312>.
- [34] Karimi, J., Somers, T.M., & Gupta, Y.P. "Impact of environmental uncertainty and task characteristics on user satisfaction with data", *Information Systems Research* (15:2), 2004, 175-193.
- [35] Keller, R.T. "Technology-information processing fit and the performance of R&D project groups: A test of contingency theory", *Academy of Management Journal* (37:1), 1994, 167-179.
- [36] Kuan, K.K.Y., & Chau, P.Y.K. "A perception-based model for EDI adoption in small businesses using a technology-organization-environment framework", *Information & Management* (38:8), 2001, 507-521.
- [37] Kuo, Y.K., & Ye, K.D. "How employees' perception of information technology application and their knowledge management capacity influence organisational performance", *Behaviour & Information Technology* (29:3), 2010, 287-303.
- [38] Levy, M., Loebbecke, C., & Powell, P. "SMEs, co-opetition and knowledge sharing: The role of information systems", *European Journal of Information Systems* (12:1), 2003, 3-17.

- [39] Levy, M., Powell, P., & Yetton, P. "SMEs: Aligning IS and the strategic context", *Journal of Information Technology* (16:3), 2001, 133-144.
- [40] Li, X., "Managerial entrenchment with strategic information technology: A dynamic perspective", *Journal of Management Information Systems* (25:4), 2009, 183-204.
- [41] Liang, T.P., You, J.J., & Liu, C.C. "A resource-based perspective on information technology and firm performance: A meta analysis", *Industrial Management & Data Systems* (110:8), 2010, 1138-1158.
- [42] Lin, H.F. "Interorganizational and organizational determinants of planning effectiveness for Internet-based interorganizational systems", *Information & Management* (43:4), 2006, 423-433.
- [43] Love, P.E.D., Irani, Z., Standing, C., Lin, C., & Burn, J.M. "The enigma of evaluation: Benefits, costs and risks of IT in Australian small and medium-sized enterprises", *Information & Management* (42:7), 2005, 947-964.
- [44] Lyons, M.H. "Future ICT systems: Understanding the business drivers", *BT Technology Journal* (23:3), 2005, 11-23.
- [45] Makadok, R. "Toward a synthesis of the resource-based and dynamic-capability views of rent creation", *Strategic Management Journal* (22:5), 2001, 387-401.
- [46] Mani, D., Barua, A., & Whinston, A.B. "An empirical analysis of the impact of information capabilities design on business process outsourcing performance", *MIS Quarterly* (34:1), 2010, 39-62.
- [47] Mehrtens, J., Cragg, P.B., & Mills, A.M. "A model of Internet adoption by SMEs", *Information & Management* (39:3), 2001, 165-176.

- [48] Melville, N., Kraemer, K., & Gurbaxani, V. "Review: Information technology and organizational performance: An integrative model of IT business value", *MIS Quarterly* (28:2), 2004, 283-322.
- [49] Melville, N., & Ramirez, R. "Information technology innovation diffusion: An information requirements paradigm", *Information Systems Journal* (18:3), 2008, 247-273.
- [50] Mendelson, H., & Pillai, R.R. "Clockspeed and informational response: Evidence from the information technology industry", *Information Systems Research* (9:4), 1998, 415-433.
- [51] Mole, K.F., Ghobadian, A., O'Regan, N., & Liu, J. "The use and deployment of soft process technologies within UK manufacturing SMEs: An empirical assessment using logit models", *Journal of Small Business Management* (42:3), 2004, 303-324.
- [52] Molloy, S., & Schwenk, C.R. "The effects of information technology on strategic decision making", *Journal of Management Studies* (32:3), 1995, 283-311.
- [53] Nguyen, T.U.H. "Information technology adoption in SMEs: An integrated framework", *International Journal of Entrepreneurial Behaviour & Research* (15:2), 2009, 162-186.
- [54] Nolan, R.L., "Managing the computer resource: A stage hypothesis", *Communications of the ACM*, (16:7), 1973, 339-405.
- [55] Nunnally, J.C., & Bernstein, I.H., *Psychometric theory*, McGraw-Hill, New York, NY, U.S.A., 1978.
- [56] Oliveira, T., & Martins, M.F. "Understanding e-business adoption across industries in European countries", *Industrial Management & Data Systems* (110:9), 2010, 1337-1354.

- [57] Overby, E., Bharadwaj, A., & Sambamurthy, V. "Enterprise agility and the enabling role of information technology", *European Journal of Information Systems* (15:2), 2006, 120-131.
- [58] Palvia, P.C. "A model and instrument for measuring small business user satisfaction with information technology", *Information & Management* (31:3), 1996, 151-163.
- [59] Pan, M., & Jang, W. "Determinants of the adoption of enterprise resource planning within the technology-organization-environment framework: Taiwan's communications", *Journal of Computer Information Systems* (48:3), 2008, 94-102.
- [60] Pavlou, P.A., & El Sawy, O.A. "From IT leveraging competence to competitive advantage in turbulent environments: The case of new product development", *Information Systems Research* (17:3), 2006, 198-227.
- [61] Petter, S., Straub, D., & Rai, A. "Specifying formative constructs in information systems research", *MIS Quarterly* (31:4), 2007, 623-656.
- [62] Premkumar, G., & Ramamurthy, K. "The role of interorganizational and organizational factors on the decision mode for adoption of interorganizational systems", *Decision Sciences* (26:3), 1995, 303-336.
- [63] Premkumar, G., & Roberts, M. "Adoption of new information technologies in rural small businesses", *Omega: The International Journal of Management Science* (27:4), 1999, 467-484.
- [64] Rai, A., Patnayakuni, R., & Seth, N. "Firm performance impacts of digitally-enabled supply chain integration capabilities", *MIS Quarterly* (30:2), 2006, 225-246.

- [65] Ray, G., Muhanna, W.A., & Barney, J.B. "Information technology and the performance of the customer service process: A resource-based analysis", *MIS Quarterly* (29:4), 2005, 625-652.
- [66] Raymond, L., & Pare, G. "Measurement of information technology sophistication in small manufacturing businesses", *Information Resources Management Journal* (5:2), 1992, 4-16.
- [67] Riemenschneider, C.K., Harrison, D.A., & Mykytyn, P.P. "Understanding IT adoption decisions in small business: Integrating current theories", *Information & Management* (40:4), 2003, 269-285.
- [68] Riquelme, H. "Commercial Internet adoption in China: Comparing the experience of small, medium and large businesses", *Internet Research* (12:3), 2002, 276-286.
- [69] Sabherwal, R., & Sabherwal, S. "Knowledge management using information technology: Determinants of short-term impact on firm value", *Decision Sciences* (36:4), 2005, 531-566.
- [70] Sambamurthy, V., Bharadwaj, A., & Grover, V. "Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms", *MIS Quarterly* (27:2), 2003, 237-263.
- [71] Sarosa, S., & Zowghi, D. "Strategy for adopting information technology for SMEs: Experience in adopting email within an Indonesian furniture company", *Electronic Journal of Information Systems Evaluation* (6:2), 2003, 165-176.
- [72] Sharma, S., *Applied multivariate techniques*, John Wiley & Sons, New York, NY, U.S.A., 1995.

- [73] Shin, I. "Adoption of enterprise application software and firm performance", *Small Business Economics* (26:3), 2006, 241-256.
- [74] Southern, A., & Tilley, F. "Small firms and information and communication technologies (ICTs): Toward a typology of ICTs usage", *New Technology, Work and Employment* (15:2), 2000, 138-154.
- [75] Tan, K.S., Chong, S.C., Lin, B., & Eze, U.C. "Internet-based ICT adoption: Evidence from Malaysian SMEs", *Industrial Management & Data Systems* (109:2), 2009, 224-244.
- [76] Tarafdar, M., & Gordon, S.R. "Understanding the influence of information systems competencies on process innovation: A resource-based view", *The Journal of Strategic Information Systems* (16:4), 2007, 353-392.
- [77] Thong, J.Y.L. "An integrated model of information systems adoption in small businesses", *Journal of Management Information Systems* (15:4), 1999, 187-214.
- [78] Thong, J.Y.L., & Yap, C.S. "CEO characteristics, organizational characteristics and information technology adoption in small businesses", *Omega: The International Journal of Management Science* (23:4), 1995, 429-442.
- [79] Thong, J.Y.L., Yap, C.S., & Raman, K.S. "Environments for information systems implementation in small businesses", *Journal of Organizational Computing and Electronic Commerce* (7:4), 1997, 253-278.
- [80] Tippins, M.J., & Sohi, R.S. "IT competency and firm performance: Is organizational learning a missing link?" *Strategic Management Journal* (24:8), 2003, 745-761.
- [81] Tornatzky, L.G., & Fleischer, M. *The process of technological innovation*, Lexington Books, Lexington, MA, U.S.A., 1990.

- [82] Tushman, M.L., & Nadler, D.A. "Information processing as an integrating concept in organizational design", *Academy of Management Review* (3:3), 1978, 613-624.
- [83] Wang, E.T.G. "Effect of the fit between information processing requirements and capacity on organizational performance", *International Journal of Information Management* (23:3), 2003, 239-247.
- [84] Wheeler, B.C. "NEBIC: A dynamic capabilities theory for assessing net-enablement", *Information Systems Research* (13:2), 2002, 125-146.
- [85] Wu, F., Yenyurt, S., Kim, D., & Cavusgil, S.T. "The impact of information technology on supply chain capabilities and firm performance: A resource-based view", *Industrial Marketing Management* (35:4), 2006, 493-504.
- [86] Yang, H.D., Moon, Y.J., & Rowley, C. "Social influence on knowledge worker's adoption of innovative information technology", *Journal of Computer Information Systems* (50:1), 2009, 25-34.
- [87] Yuen, Y.Y., Yeow, P.H.P., Lim, N., & Saylani, N. "Internet banking adoption: Comparing developed and developing countries", *Journal of Computer Information Systems* (51:1), 2010, 52-61.
- [88] Zhu, K., Kraemer, K., & Xu, S. "Electronic business adoption by European firms: A cross-country assessment of the facilitators and inhibitors", *European Journal of Information Systems* (12:4), 2003, 251-268.

## Appendix

### Varimax rotation factor pattern for the items measuring reasons for IT adoption

Statement	Item	Component			
		1	2	3	4
Improvement of staff creativity and innovativeness	ITEOI1	<b>0.849</b>	0.212	-0.149	0.056
Organizational knowledge development	ITEOI2	<b>0.836</b>	0.107	0.057	0.051
Response to internal and external changes	ITEOI3	<b>0.627</b>	0.268	0.205	0.120
Improved information sharing	ITEOI4	<b>0.558</b>	0.310	0.192	-0.041
Improvement of staff productivity	ITEOI5	<b>0.540</b>	-0.060	0.425	-0.026
Fulfilling the ISO requirements	EP1	0.150	<b>0.870</b>	0.190	0.107
Fulfilling the requirements of customer/supplier standards	EP2	0.260	<b>0.867</b>	0.146	-0.025
External requests for better information transmission and communication	EP3	0.216	<b>0.837</b>	0.054	0.014
Access to the reliable, relative and precise information	IPC11	0.160	0.142	<b>0.842</b>	-0.006
Access to the up to date information	IPC12	0.175	0.108	<b>0.824</b>	0.140
Rapid access to the required information at the time of need	IPC13	0.318	0.291	<b>0.688</b>	-0.025
Threat of companies offering similar products	CP1	-0.038	0.128	-0.087	<b>0.864</b>
Threat of companies offering substitute products	CP2	-0.129	0.026	-0.031	<b>0.852</b>
Extent to which firm's survival is being threatened by counterparts within the industry	CP3	-0.070	-0.103	0.372	<b>0.666</b>