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The impact of technological innovation capabilities on competitive performance of Iranian ICT firms

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Abstract

Recently many researches have studied technological innovation capabilities (TICs) and their impacts on firm's competitive performance in the field of manufacturing industries. This paper pursued Yam et al. (2004) framework to study the relevance of TICs and firm's competitive performance in a mainly-service-based industry in Iran (ICT). Empirical data were collected through a questionnaire from 218 Iranian ICT firms. Structural equation modeling (SEM) was applied to examine the drivers of competitive performance in these firms. The results of this study supported the expected positive relationship between TICs and competitive performance of Iranian ICT firms. Further, the results verified that resource allocation, R&D, learning and marketing capabilities can significantly improve the innovative outcomes of Iranian ICT firms. The paper contributes to TICs literature by providing empirical evidence on how ICT firms can enhance their competitiveness by utilizing TICs.

Keywords

Capability, Competitive performance, ICT, Innovation, Technology.

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Introduction

Nowadays dynamic business environment gets firms to enhance their capabilities for developing and commercializing new technologies faster than their competitors and also facilitating the process of innovation and diffusion of internal innovation for strengthening competitive advantage. In such an environment, the inability to innovate leads to business stagnation and getting out of business (Yam et al., 2004). Scholl (2005), states that without innovation, it's not possible to speak about growth and competitiveness. The evolution of resource based view (RBV) in management and economics resulted in the development of the concept of technological innovation capability (TIC). Based on RBV, output discrepancies between firms are resulted from discrepancies in valuable, rent-generating, and difficult to be substituted resources or so called capabilities (Hamel & Prahalad, 1994: 236). In order to compete on new products, firms should compete on the capability of developing those (Prahalad & Hamel, 1990). Developing their own TICs can be helpful for firms and results in enhanced competitive performance (Romijn & Albaladejo, 2002). In UK, The Department of Trade and Industry (DTI) conducted a research in different manufacturing industries in order to find out the drivers of innovative performance. Technological innovation capabilities were found the most influential drivers that stimulate the innovative performance (DTI, 2003).

According to Shan and Jolly (2010) technological innovation capability has been widely studied in different fields, such as resource based view (Grant, 1991), distinctive competency (Hitt & Ireland, 1985), dynamic capability (Prahalad & Hamel, 1990; Nelson, 1991) and knowledge based view (Kogut & Zander, 1992; Grant, 1996). Many researchers in all of these literature streams indicate that TICs can be a source of competitive advantage. Almost all of these researches have been conducted in the context of manufacturing firms and try to develop a framework to describe the relevance of TICs and economic outcomes in this context (Camisón & Villar-López, 2014; Carlsson et al., 2002; Silvestre & Neto, 2013; Shan & Jolly, 2013; Voudouris et al., 2012; Collinson & Wang, 2012; Yam et al., 2010).

This manufacturing based approach by these literature streams in the fields of TICs is not consistent with the increasing role of service sector as based on the World Bank data, the service sector proportion of world GDP has been reached to over 68% and almost in majority of countries the service sector is the largest sector of the economy. Contrary to especial characteristics of service and the significant role of innovation in increasing competition in this sector, not enough attention has been paid to service sector in the field of TICs and there are very few studies that provide empirical evidence of the impact of TICs on competitive performance in this sector (e.g. Ortega, 2010; Kumar et al., 2008).This perspective has begun to change with the development and expansion of services and the increasing role of service sector in global economy (Ferraz & Santos, 2016). Along with the great strategic importance assumed by the concept of TIC in the service sector and high competitive rivalry in this sector, it seems that more attention should be paid to examining the relevance of TICs and competitive performance in service firms (Moreira et al., 2016).

As the importance of information and communication technology (ICT) has been grown in global economy since the 90's afterward, the researcher in the field of TICs have done more empirical research in the field of technological innovation capabilities of ICT sector (e.g. Collinsona & Wang, 2012; Banerjee, 2012; Gnyawali & Park; 2011; Lamin & Dunlap, 2011; Ortega; 2010; Tseng et al., 2012; Stuart & Podolny, 1996). In the most of these researches the manufacturing aspects of ICT industry have been considered. In this context, it seems that examining the impact of TICs on the performance in the service aspects of ICT industry need to be worked on. Based on these assumptions, in order to develop TICs literature in the service sector, this study, as its main objective, is looking for examining the impact of TICs on the competitive performance in ICT firms in Iran.

The present study contributes to this stream of knowledge in three ways. First, it's almost the first time that Iran as a developing country in this field is being considered. Second, based on ISIC Rev.4 (2008, 278), it can be inferred that Iranian ICT sector is a mainly-service-based sector (not manufacturing sector similar to almost all of the

existing studies) and almost all of the Iranian ICT firms are in the service subsectors of ICT. So this study tries to consider the impact of TICs on the competitive performance in a service subsector of Iran ICT industry. Third, this study examined the current manufacturing-based frameworks and tries to develop a framework to studying the ICT sector.

The subsequent sections are structured as follows. First, an overall overview of the core concepts of the study (TICs and firm competitive performance) is provided. Then research hypotheses are discussed and the research model is presented. Explanation of research methodology and conduct of an empirical study are described in the next section. Afterward, data analysis and conclusion with a discussion of the results are provided. Finally, limitations and directions for future researches are described.

Technological innovation capabilities (TICs)

TICs have an important role in the study of innovation in the business field. But what TIC really is? To answer this question the major works related to the concept of technological innovation capability have been studied. Because of the association with many other related concepts and the multi-dimensional essence of TICs, scholars have defined TIC from different points of view as thought there is not a clear consensus on the definition of the concept of TIC.

TIC is a concept that embraces many different resources and is so complex, multi-disciplinary, and impossible to measure directly (Chiesa et al., 1996; Guan & Ma, 2003). Not only does technological innovation depend on technological capability, but it also requires innovation capability in the area of manufacturing, marketing, organization, strategy planning, learning, and resources allocation (Yam et al., 2004; Romijn & Albaladejo, 2002). Thus TICs of a firm are reflected by different variables (Chiesa et al., 1996; Guan & Ma, 2003).

Lall (1992) defined TICs as the skills and knowledge needed to effectively absorb, master, and improve existing technologies, and to create new ones. Accordance with this definition Shan and Jolly

(2013) defined TIC as the capability of a company to select, acquire, absorb, and integrate new technology, as well as to manage and organize various resources to produce new technology. Burgelman et al. (2004) defined TIC as a comprehensive set of characteristics of an organization that facilitates and supports its technological innovation strategies. TIC is a kind of special assets or resources that include technology, product, assets, or knowledge, experience, and organization (Guan & Ma, 2003). OECD (1997) in the Oslo Manual identifies four types of innovation: product, process, marketing, and organizational innovation. Technological innovation involves product and process innovations (Camisón & Villar-López, 2014).

As it can be inferred from above argument, there are different approaches to define the concept of TIC in the literature. In a spectrum it seems that some definitions come from the field of innovation management (e.g. Guan & Ma (2003), Evangelista et al. (1997)) and some others come from the field of technology management (e.g. Shan & Jolly (2013), Lall (1992)). Simultaneously in another spectrum it seems that some scholars definitions of TIC focus on firm interaction with its environment (e.g. Adler & Shenbar (1990), Shan & Jolly (2013)) and some others focus on internal process of the firm (e.g. Camisón & Villar-López (2014), Marcelle (2005)). It seems that succeeding scholars have more innovational and internal point of view and precedent ones have more technological and external point of view.

The framework for measuring TICs

Nonetheless so many scholars have defined and worked on the concept of TIC, a few of those develop their own framework. So there aren't so many unique frameworks to study TIC and scholars mostly have used a few frameworks have been already existed.

Probably it was Lall (1992) for the first time that tried to present a framework for TIC. According to him there are three classification of TIC: investment capability, production capability, and linkage capability. Investment capabilities are the skills needed to identify,

prepare and obtain a technology. Production capabilities cover both process and product technologies. Linkage capabilities are the skills needed to transmit information, skills and technology.

Christensen (1995) categorized TIC into four classes: Scientific research assets, process innovative assets, product innovative assets, and aesthetic design assets. Chiesa et al. (1996) developed a model for auditing innovation capability which identifies two methods to evaluation a firm: a process audit and a performance audit. They introduced in their framework a list of indicators of the characteristics of good practice and process.

Burgelman et al. (2004: 87) in their innovative capabilities audit framework proposed five audit dimensions including: Resource availability and allocation, Capacity to understand competitor's innovative strategies and industry evolution, Capacity to understand technological developments, Structural and cultural context, Strategic management capacity. Integrating the findings of relevant literature Yam et al. (2004) grouped the elements they found for auditing TIC of the firms into seven capability dimensions. The seven dimensions are: learning, R&D, manufacturing, marketing, organizing, resource allocation and strategic planning.

Because of the comprehensiveness and ease of understanding of the Yam et al. (2004) audit framework, this study alike to many scholars after them (such as Guan et al. (2006); Lau et al. (2010); Tseng et al. (2012)) uses their audit framework for measuring the TICs of the firm in this study.

According to Yam et al. (2004) every seven dimensions of TIC can be defined in following:

- Learning capability is the capability to identify, assimilate, and utilize knowledge necessary for survival in competitive environment.
- R&D capability is the capacity to integrate R&D strategy, project implementation, project portfolio management, and R&D expenditure.
- Resources allocation capability refers to the ability to acquire

and expand technological, human, and financial resources in the innovation process.

- Manufacturing capability is the ability to transform R&D results into products, in accordance with design request of customer.
- Marketing capability refers to the ability to publicize and sell products on the basis of understanding consumer's current and future needs and competitive environment.
- Organizing capability indicates the capacity to constitute a well-established organizational structure and adopting good management routines.
- Strategic planning capability refers to the capacity to identify external opportunities and threats and internal strengths and weaknesses.

Firm's competitive performance

There are many researches have studied the relationship between integration of TIC in a firm and its greater competitiveness which also results in higher performance (Pakes, 1985; Prahalad & Hamel, 1990; Nelson, 1991). According to Shan & Jolly (2010) The TIC-firm competitive performance relationship, has been widely discussed in different literature streams. Each of those implies that TICs can be a source of competitive advantage (Shan & Jolly, 2010).

The research context is the sector of ICT, so based on an extensive review of the literature (such as Guan et al. (2006), Yam et al. (2004), Guan & Ma (2003), Evangelista et al. (2001), OECD (1997)) a long list of items were identified. Two types of performance indicators were adopted. These indicators have more congruity with the firms that mostly are categorized in the service sector. The two types of performance indicators are innovation performance and sales performance.

Innovation performance is measured in terms of the number of commercialized new products expressed as a percentage of all products in the firm over the past three years (Yam et al., 2004). The increase in commercialized products contributes to innovative results.

Sales performance is measured in terms of the average annual sales growth rate due to technologically innovative products over the last three years (Yam et al., 2004). Sales growth rate is a sign of a firm's market penetration. The next section has more information about all concepts presented and the entire hypotheses needed.

Research hypotheses

Learning capability and firm competitive performance

Freeman (2002) stressed the competitive performance is closely related to learning. Yam et al. (2010) argued that learning capability is highly correlated to the other capabilities so learning capability indirectly can enhance the competitive performance of the firm. A firm with more strong learning capability has more capacity to absorb new knowledge from competitors and is more efficient to develop capabilities to upgrade process innovativeness (Cohen & Levinthal, 1990). Surveying these studies the first hypothesis is proposed:

H1: the greater a firm's learning capability, the better its competitive performance.

R&D capability and firm competitive performance

Traditionally, only the investment into R&D projects is considered as a major focus of innovation (Tseng et al., 2012). Shan & Jolly (2010) found that investment in R&D has a positive effect on the performance. R&D activities are a vital component of the TIC activities of firms and the most important intangible innovation expenditure (Evangelista et al., 1997). Production capabilities are essential to the firm's technology development (Bell & Pavitt, 1993). Surveying these studies the second hypothesis is proposed:

H2: the greater a firm's learning capability, the better its competitive performance.

Resource allocation capability and firm competitive performance

Resources allocation capability ensures that a firm has sufficient resources in the process of innovation (Yam et al., 2004). The most influential factor on sales growth is resources allocation capability

(Yam et al., 2010). These authors also investigate the effect of firm size on resource allocation capability and competitive performance and find that in large size and small size firm the capability to allocate resources effectively is one of the most influential factors. Lau et al. (2010) explained that the firms which offer many products should try more on development of resource allocation capability. Hence, the third hypothesis is proposed:

H3: the better the resource allocation capability the better the firm's competitive performance.

Manufacturing capability and firm competitive performance

Evangelista et al. (1997) found that investment in machinery is the most important source of innovation in the most Italian manufacturing firms. They also found that quality of product is a vital component of the strategic planning of the manufacturing firms in Italy. Yam et al. (2010) found that manufacturing capability has more significant effect on competitive performance of large firm size rather than small firms. The concept of production capability in Lall (1992) studies is almost the same as the concept of manufacturing capability in Yam et al. (2004) study. In view of these ideas, the hypothesis is proposed as following:

H4: the greater a firm's manufacturing capability, the better its competitive performance.

Marketing capability and firm competitive performance

According to Camisón & Villar-López (2014), among different categorization of innovation typology, one of the most commonly accepted one is: marketing innovation, product innovation, process innovation and organizational innovation. Yam et al. (2010) based on data was gathered from a survey of 200 manufacturing firms in Hong Kong argued that one of the most influential factor on competitiveness in Small firms is marketing capability. Lau et al. (2010) by analyzing the data from Chinese firms argued that marketing capability has one of the strongest relationships with innovation performance of the firm among all types of capabilities. Therefore the hypothesis is proposed as:

H5: the better marketing capability, the better the firm's competitive performance.

Organizing capability and firm competitive performance

Nowadays, the customer needs have changed from low-mix and big-size to high-mix and small-size. In order to cope with this change, firms must have a strong capability in organization of different activities among different organizational functions (Yam et al., 2010). Souitaris (2001) implied two classifications of activities that firm can make to create its own channels of knowledge and linkages, which is surveying external information and collaborating with external organizations. Bell & Pavitt (1993) extended the concept of TICs to include resources required managing the accumulation of the change in organization. These resources are accumulated and embodied in people and organizational system. Therefore the hypothesis is proposed as:

H6: the greater the firm's accumulation of organizing capability, the better its competitive performance.

Strategic planning capability and firm competitive performance

Between firms, the pace of technological innovation puts organizations under severe pressure to innovate effectively and to act strategically within their industries to establish commercially profitable positions encountering technological change (Utterback, 1994: 135). Strategic planning capability measured a firm's capacity to recognize external opportunities and threats and internal strengths and weaknesses (Yam et al., 2010). Yam et al. (2010) indicated that a firm with strong strategic planning capability could properly match its technological and marketing strategies so as to develop a new product with fine performance that satisfies customer needs. Reviewing these studies the last hypothesis is proposed:

H7: the greater the firm's strategic planning capability, the better its competitive performance.

Based on above hypotheses the research conceptual model of this study illustrates in Figure 1.

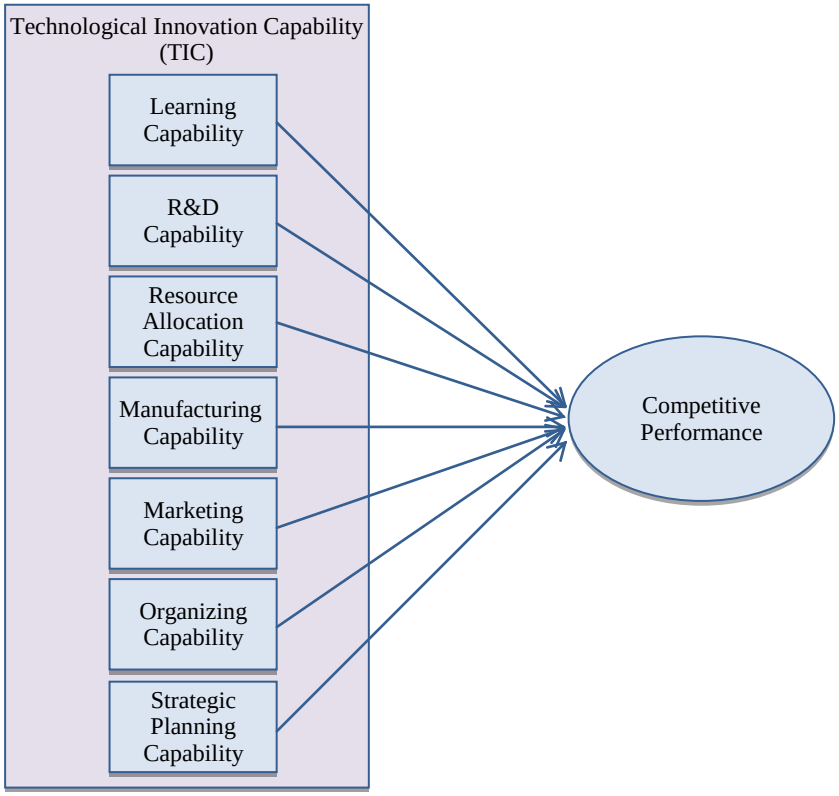

Fig. 1. TIC – The research conceptual model

Research methodology

Regarding the research purpose, this study is an applied research and according to data gathering, it is a descriptive one. The main objective of this study is to consider the impact of the TIC on firm's competitive performance. A survey questionnaire was designed and based on its results, empirical evidences on the TIC and its relationship with competitive performance could be obtained.

In order to measuring independent variables a list of items was collected from literature. In collaboration of three ICT industrial managers and four innovation management and ICT academicians the most relevant items with the research context were selected. The respondents were asked to give opinions on to what extend do they agree with the statements regarding to firm’s TIC by means of seven-

point Likert response scales ranging from "strongly disagree" (1) to "strongly agree" (7). Competitive performance was measured by two items as dependent variables. The first one was Innovation performance that is measured in terms of commercialized new products expressed as a percentage of all products in the firm over the past three years (Yam et al., 2004). The other one was sales performance which is measured in terms of the average annual sales growth rate due to technologically innovative products over the last three years (Yam et al., 2004).

According to Yam et al. (2004) TICs questionnaire and above mentioned items selected, a questionnaire was designed. Based on the context properties, the wordings of the questionnaire with collaboration of ICT experts were slightly changed. Then, it was modified and translated into Persian. In order to identification of any problems in translation of the questionnaire, the sequencing of questions and the level of comprehensibility of the draft questionnaire, a pilot study was conducted. Both English and Persian versions of the questionnaire were sent to 14 industrial managers, officials and academicians who were experiences in both the industrial and the academic sectors of ICT. Their comments and feedbacks helped us to finalize the questionnaire.

Pilot study and sampling

In order to be confident for the high level of content validity of questionnaire, five academicians in the field of ICT and innovation and seven ICT managers were asked to complete the questionnaire. A pretest was then carried out with a sample of 23 managers working in ICT firms in Iran. They were asked to comment on the clarification and appropriateness of the items in the questionnaire.

To select the sample population, the directory of ICT firms published by ICT syndicate was used. The total numbers of ICT firms was 4375. To select innovative firms a subdirectory of more innovative firms of syndicate which was selected according to R&D expenditure was used. The number of firms in this subdirectory was 576 (around 13% of total). The questionnaire was sent to the firms by

two ways: email and fax, and also personal contact in company office and Iran telecom exhibition (October 2013). The questionnaire respondents were managers, vice presidents or CEOs. Gathering the questionnaires lasted around 6 months. Finally using simple random sampling method 218 samples were collected. This is a response rate of 44.7%. The demographic characteristic of the sampled firms are shown in Table 1.

It can be beneficial to know the type of ownership of the firms. According to Table 1, among 218 firms, 37 firms are public listed companies (17.0%), 91firms are private firms (41.7%), 67 firms are state owned enterprise (30.7%) and 23 firms are foreign joint venture (10.6%).

Table 1. Demographic characteristic of the sampled firms

	Number	**Percentage**
Ownership		
Public listed company	37	17.0%
Private firm	91	41.7%
State owned enterprise	67	30.7%
Foreign joint venture	23	10.6%
Number of employee		
<50	58	26.6%
50-99	74	33.9%
100-199	36	16.5%
200-299	32	14.7%
>=300	18	8.3%
Total	218	100.0%

Results

Data analysis

Table 2 represents means, standard deviation and coefficient of (CV) of the study variables.

In this research, in order to verify hypotheses, structural equation modeling (SEM) has been used by using Amos software version 23. Because the theoretical basis is strong and this research tries to further testing and development of them, the covariance-based approach was used to analyze the data. A two-step structural equation modeling consists of the measurement model and the structural model, were exploited to confirm the reliability and validity of the measures before

examining the structural relationship between construct. This has employed maximum likelihood for estimation method as it provides a consistent approach to parameter estimation problems that can be developed for s large variety of estimation situation.

Table 2. Descriptive statistics of TIC scores and performance scores

Variables	Mean	Std. Deviation	CV
Learning	4.51	1.29	0.29
R&D	5.01	1.12	0.22
Resource Allocation	4.60	1.38	0.30
Production	4.10	1.71	0.42
Marketing	4.49	1.50	0.33
Organizing	4.16	1.69	0.41
Strategic Planning	4.21	1.55	0.37
Competitive Performance	4.56	1.51	0.33

Measurement model

In order to test the measurement model, Confirmatory factor analysis (CFA) was used. As shown in Table 3, all items have a factor loading more than 0.5 (acceptance threshold) and a very acceptable t-value (more than 3). The measurement model was assessed via the reliability, discriminant validity and convergent validity of the constructs measures. In Table 3, it can be observed that Cronbach's alpha coefficients of all constructs are more than 0.7, which is a very acceptable amount for reliability of construct (Kline, 1998: 157).

The average variance extracted (AVE) was measured to assess convergent validity of the measurement. Based on table 3, the AVE of all constructs exceed exceeded the acceptance threshold value of 0.5 (Hair et al., 1998). So, the current data have acceptable convergent validity.

As a discriminant validity test, correlations between the constructs were measured to determine whether they were significantly different from 1. The confidence intervals of correlations at 95% confidence level did not contain 1. So it can be said that there is adequate discriminant validity in this study. These results are satisfactory and allow continuing with the evaluation of the structural model.

Table 3. Measurement model fit

Construct	Item	Mean	Factor Loading	t-statistics	Cronbach's alpha	AVE
Learning Capability	LC1	4.33	0.63	8.83	0.856	0.56
	LC2	4.38	0.58	8.21		
	LC3	4.86	0.51	8.16		
	LC4	4.45	0.72	9.76		
	LC5	4.18	0.58	8.19		
	LC6	4.86	0.62	9.01		
R&D Capability	RD1	5.44	0.59	7.94	0.776	0.53
	RD2	5.59	0.68	8.65		
	RD3	4.38	0.62	8.39		
	RD4	5.79	0.61	8.12		
	RD5	4.38	0.76	9.43		
	RD6	4.48	0.53	7.29		
Resource Allocation Capability	RA1	4.32	0.65	9.65	0.745	0.49
	RA2	3.99	0.68	9.89		
	RA3	5.24	0.61	8.69		
	RA4	4.98	0.79	10.81		
	RA5	4.47	0.81	12.34		
Production Capability	PC1	3.99	0.50	6.48	0.843	0.61
	PC2	4.05	0.55	7.23		
	PC3	4.67	0.63	8.19		
	PC4	3.68	0.56	7.42		
	PC5	4.11	0.61	8.10		
Marketing Capability	MC1	4.38	0.62	9.25	0.833	0.64
	MC2	5.01	0.55	7.56		
	MC3	4.18	0.59	8.81		
	MC4	4.69	0.55	7.66		
	MC5	4.19	0.63	10.29		
Organizing Capability	OC1	3.41	0.59	6.26	0.795	0.48
	OC2	3.98	0.58	5.89		
	OC3	4.34	0.56	5.53		
	OC4	4.26	0.61	6.87		
	OC5	4.81	0.53	5.65		
Strategic Planning Capability	SP1	3.43	0.52	5.12	0.793	.059
	SP2	4.52	0.58	5.62		
	SP3	3.88	0.59	5.87		
	SP4	5.01	0.68	6.34		
Competitive Performance	IP	4.50	0.68	12.47	0.729	0.56
	SP	4.56	0.71	13.93		

Based on Table 3, it can be useful to depict the importance-performance matrix. Each item's mean can be exploited as the item's performance and the item's importance can be represented by its factor loading (Fig. 2). The items with low performance and high importance such as RA2 should be at the focal point of improvement efforts. The

resources which have been assigned to the items with high performance and low importance such as PC3 and OC5 can be decreased to be assigned to boost the performance in items such as RA2.

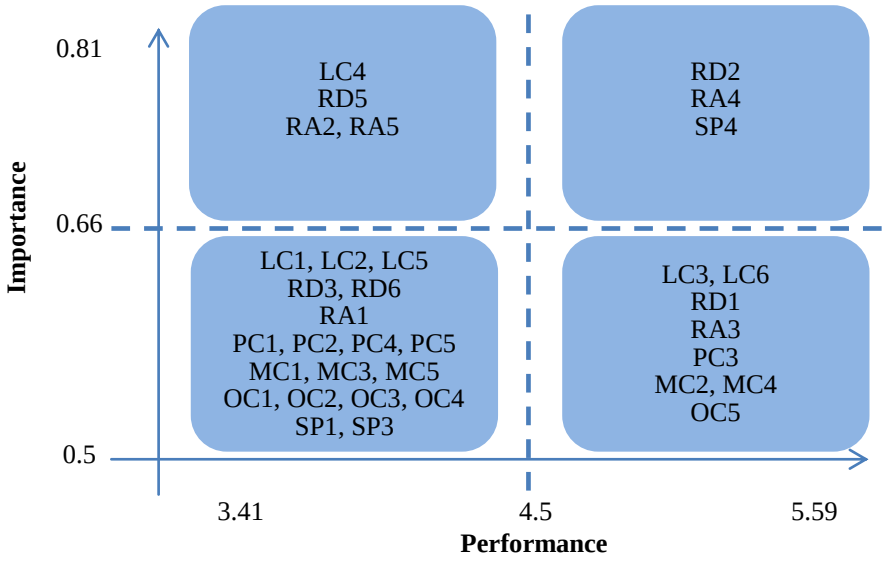

Fig. 2. Importance-performance matrix

Structural model

The overall model fit indices for CFA are shown in table 4. The results indicated that the measurement model were subjected to testing and were found valid. Figure 2 shows the overall explanatory power and path regression coefficients that indicate the direct influences of predictor on the predicted latent constructs. The structural model in the SEM was performed and evaluated by examining fit indices and variance explained estimates. In table 4 a variety of fit indices of structural model and the cut-off values of them are presented to assess the model's overall fit.

Table 4. Structural model fit

Index	Value	Cut-off value
Chi2/DF	2.782	<3
CFI	0.921	>0.9
NFI	0.947	>0.9
GFI	0.868	>0.9
RMSEA	0.0563	<0.08

In order to lessen the sensitivity of the chi-square statistics, the value of chi-square is divided by the degrees of freedom. The result of this division was 2.782 that are within the acceptable cut-off range. The comparative fit index (CFI=0.921) and the normed fit index (NFI= 0.947) are passed the acceptance minimum of 0.9. The goodness of fit (GFI=0.868) is slightly below the threshold of minimum 0.9, but according to Etezadi-Amoli and Farhoomand (1996) GFI more than 0.8 is also acceptable. The root mean square error of approximation (RMSEA=0.0563) is also passed the acceptance level of below 0.08.

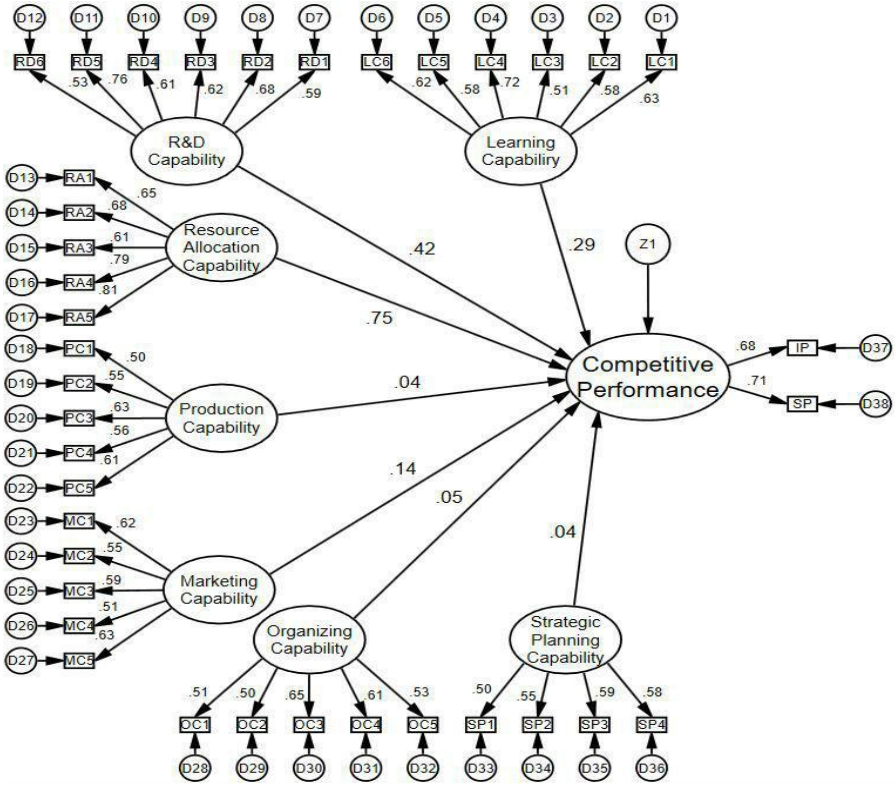

Fig. 3. The results of structural model

According to Table 4, the overall fit indices of the structural equation modeling in this study indicate that the fit of the model is reasonably well. Considering these fit indices, now the structural relations and their path coefficients can be analyzed.

Table 5. Analysis of research hypothesis

Hypothesis	Independent variable	Dependent Variable	Standardized Estimate	t-statistic	Result
H1	Learning Capability	Competitive Performance	0.293	3.62***	Accepted
H2	R&D Capability	Competitive Performance	0.416	4.47***	Accepted
H3	Resource Allocation Capability	Competitive Performance	0.751	9.67***	Accepted
H4	Production Capability	Competitive Performance	0.040	1.67	Rejected
H5	Marketing Capability	Competitive Performance	0.142	2.15*	Accepted
H6	Organizing Capability	Competitive Performance	0.051	1.24	Rejected
H7	Strategic Planning Capability	Competitive Performance	0.044	0.18	Rejected

*** Significant at the P< 0.001 level (two-tailed)
* Significant at the P< 0.05 level (two-tailed)

In order to test research hypothesis, Table 5 presents the path coefficients and t-statistics. The hypothesis testing showed that Learning capability (B=0.293, t=3.62) has significant effect on ICT firm's competitive performance. Thus the first hypothesis (H1) was accepted. Regarding the second hypothesis, it has been found that R&D capability (B=0.416, t=4.47) has a high influence on ICT firm's competitive performance. So the second hypothesis (H2) was accepted. Furthermore, the results supported the third hypothesis that resource allocation capability (B=0.751, t=9.67) has a significant effect on ICT firm's competitive performance. So the third hypothesis (H3) was accepted too. The forth hypothesis of this research was not supported. It has been found that production capability (B=0.040, t=1.67) does not play a significant role in effecting on ICT firm's competitive performance. So the forth hypothesis (H4) was not accepted.

Based on Table 5, it can be interpreted that marketing capability (B=0.142, t=2.15) has a positive relationship with ICT firm's competitive performance. High significance of this relationship resulted in accepting of fifth hypothesis (H5). Regarding the sixth hypothesis, it has been found that organizing capability (B=0.051,

t=1.24) did not have significant effect on ICT firm's competitive performance. So the sixth hypothesis (H6) was not accepted. According to table 5, the last hypothesis (H7) of this research was not accepted too. Because the significance of the effect of strategic planning capability (B=0.044, t=0.18) on ICT firm's competitive performance was not confirmed. In brief, the hypothesis H1 to H3 and H5 were accepted and the hypothesis H4, H6 and H7 were not accepted.

Discussion

This study shows new ideas and relationships beyond existing literature. The results of this study have implications for innovation management and future research. The findings of this study in compatibility with conceptual model show that the capabilities in resource allocation, R&D, learning and marketing, strongly improve the ICT firm's competitive performance in Iran.

Because of shortage in financial resource in Iran which worst after sanctions, it was not wonderful that resource allocation is the most influential variable on competitive performance in ICT firms. Availability of financial resources for investment in new product development and running new innovative projects in R&D process is a vital component in ICT as an industry with an intense competition. Many respondent firms strongly agreed that they cannot provide steady financial supplement in innovation process. Many firms claimed that some important new product developments were stopped because of financial bottleneck and by new financial resource inflow they can be completed. This finding is similar to other technological innovation studies identified the lack of financial and human resources as key constraints for innovation (Guan, 2002; Sirilli & Evangelista, 1998).

As an industry, ICT with a fast innovative product development rate alone and as a facilitator for other industries should have outstanding R&D activities. The findings of structural equation modeling shows that Iranian firms operating in ICT industry should be concerned more and more about the level of their R&D activities if

they want to have more competitive performance. The strong effect of R&D capability on competitive performance is in line with the idea that for being more competitive, firms should have more attention to customer needs in different steps in R&D process and data from contact points should be one of the most important ones in R&D department. This is consistent with previous empirical findings indicating the crucial role of R&D expenditures in the innovation process as it conditions knowledge creation as well as firms' capacity to absorb external knowledge (Mothe & Thi, 2010).

In this study, learning capability as the third most influential independent variables has effect on competitive performance of ICT firms. This finding is consistent with previous literature findings indicating that a firm with more strong learning capability has more capacity to absorb new knowledge from other competitors and is more efficient to develop complementary capabilities to enhance product and process innovativeness (Cohen & Levinthal, 1990; Freeman, 2002). In a transforming business environment in ICT industry which connecting more discipline and knowledge continually, the capability to identify, assimilate and utilize knowledge whether from inside of the firm or from outside is an absolute prerequisite.

The fourth and the last effective capability on competitive performance are marketing. This is in consistent with previous empirical findings indicating innovation as a process that includes the technical, design, manufacturing, management, and commercial activities involved in the marketing of a new or improved product (Freeman et al., 1987: 163). The firms with higher marketing capability can generate more innovative ideas and products based on a close relationship with customers and meeting their needs before competitors in ICT industry. This is in line with the idea that cooperating with customers allows for a better understanding of new market needs and demands, enabling to define the rate and direction of innovation as well as to anticipate market trends (Klomp & Van Leeuwen, 2001).

These findings are consistent with Yam et al. (2004) that resource allocation, R&D and marketing capabilities are significant

contributors of competitive performance. However, the findings are inconsistent with Yam et al.'s (2004) study that learning capability is not correlated with competitive performance. Also the findings are not in line with Yam et al.'s (2004) study that strategic planning capability is correlated with competitive performance.

Inconsistent with the hypothesized model, the findings of the study show that production, organizing and strategic planning capabilities are not correlated with competitive performance of Iranian ICT firms. This result is similar to Yam et al.'s (2004) study that manufacturing and organizing capability was found to be unrelated to innovation performance. The absence of relationship between organizing capability and competitive performance may be due to the substantial time lag usually associated with the return on investment of such a long-term strategy. When implementing organizational changes such as new work organizations or new knowledge management systems, employers and employees are involved in a long-term process of adaptation and learning, which does not immediately result in substantial improvement in innovative performance (Mothe & Thi, 2010).

Conclusion

This study was motivated by the aim to gain better insight into TIC development in a developing economy. More precisely, it was tried to see whether technological innovation capabilities have any significant impact on the firm's competitive performance in ICT industry of Iran. Recent studies in the field of TIC do not pay sufficient attention to the ICT industry especially in the developing country such as Iran. In line with the previous study that demonstrated the role of TIC in competitive performance in industrialized countries, this study shows that the same model can also be valid in a developing economy.

This study makes a contribution to two separate bodies of literature. First, this study contributes to the resource based view by providing evidence in support of a positive influence of technological innovation capabilities on firm competitive performance (Lau et al., 2010; Shan & Jolly, 2010; Yam et al., 2004). Second, this study

presents a general view about the main technological innovation capabilities that have effect on the competitive performance of the firms in ICT industry. Since the majority of studies in the field of TIC concentrate on manufacturing industry in industrialized countries, the study in ICT and in Iran as a developing country can have considerable contributions for the researchers.

The findings from the survey provide empirical evidence and insights about the current TIC status of Iranian ICT firms. Based on a study conducted on 218 firms from the Iranian ICT sector, consistent with the literature, the results of the hypothesized model verified that there exists a positive correlation between TICs and the competitive performance of Iranian ICT firms. Resource allocations, R&D, learning and marketing capabilities are in turn the four most important TICs that have been playing an essential role in improving the innovative outcomes of Iranian ICT firms. These findings provide specific evidence to support the importance of TIC on competitive performance (Yam et al., 2004), especially in Iranian ICT industry.

For managers in the region, these findings are important as it identifies that a more balanced development of multiple TICs is required. While resource allocation capability is vital for success of innovation, the findings show that firms should also concentrate on other innovation capabilities (i.e. R&D, learning and marketing) for better coordination of resource allocation activities. Sometimes in case of time or financial restrictions, it's possible to concentrate on R&D and learning capability and procedures and attain a higher and more innovative outcome. Also, it can be inferred from the findings that marketing capability in presence of a neat strategic fit can have innovative idea inputs for new product developments and improves competitive performance of ICT firms.

These findings provide a foundation for ICT firms considering how to arrange their resources most effectively to improve their TICs and increase their innovation performance and outcomes. For a proper arrangement, based on the results and importance-performance matrix, the following suggestions for improvement can be presented to Iranian ICT firm's managers:

Passing lessons learned across boundaries and time: In order to lessen the cost and time of doing a task or project, exploitation of the previous experiences and lessons learned has a high priority in the business routines in ICT firms. Applying Knowledge management skills along with learning by sharing procedures in organization can be recommended for passing the organizational experiences across boundaries and time.

High level of investment in R&D projects and providing steady capital supplement in innovation activity: with regard to the high rate of innovativeness and competition in ICT industry, the firms should invest in R&D projects and provide steady capital supplement in innovation activity. In order to have more innovative outcomes, it seems that Iranian ICT manager should invest more in R&D projects. The current level of investment in R&D and capital supplement in innovation activity is below the amount of an innovative ICT firm and should to be increased.

Attaching importance to human resource: human resource in Iranian ICT firms is one of the most important sources of innovativeness. Attaching high importance to human resource assures the flow of innovation in firms and prevents from transition of human resource to competitor firms. The human resource with high perception of its importance can be more innovative.

Study limitations and directions for future researches

This study is subject to a number of limitations which also can be exploited as potential fields for future studies. Because of these limitations, the interpretations from the study results must be considered tentative rather than definitive. First, the data in this study is obtained from the questionnaires which were filled by managers and firms themselves that is not the best judge on their own performances. In future research for a better generalization of interpretations, a multiple informant approach could be designed. Second, ICT as a large industry consists of so many sub-industry and therefore the interpretations from the results of this study are broad interpretations and for narrow interpretations for each sub-industry the sampling

approach should be modified to include only a narrow sub-industry group.

Third, it seems in order to have a more comprehensive framework to study TIC future study can add some important variables as technological innovation capability to this audit framework such as linkage capability (Lall, 1992), absorptive capacity (Cohen & Levinthal, 1990) and so on. Forth, it is hard, time consuming and problematic for respondents to have quantitative assessment from innovation performance and sales performance. In future research in order to solve this problem it can be useful to change this measurements by qualitative ones or to cross-validate them by information from other sources.

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