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Case Study

The Efficiency of Innovative Techniques in Improving New and Traditional Standards of Corporates' Performance

Kianoosh Mansourkhani [a], Majid Zanjirdar [a,*], Majid Davoodi Nasr [b], Mohammad Izadikhah[c]

[a] *Department of Finance, Arak Branch, Islamic Azad University , Arak, Iran*
[b] *Department of Accounting, Arak Branch, Islamic Azad University, Arak, Iran*
[c]*Department of Mathematics, Arak Branch, Islamic Azad University, Arak, Iran*

ARTICLE INFO	ABSTRACT
	Innovation is one of the basic tools of growth strategies to enter new markets, increase market share and create a competitive advantage. The purpose of this study is to evaluate the efficiency of innovative techniques in improving new and traditional criteria of ICT field companies' performance during the years 2013 to 2017. Based on this goal, the research was conducted qualitatively and quantitatively. Based on Cochran sampling, 8 companies were selected as a statistical sample. In the first phase, to identify and determine the centers of decision-making units, inputs and outputs of the departments through Delphi method, distribution of questionnaires and aggregation of opinions of individuals and in in the second phase, the classification of model inputs and outputs and weighting of parameters by Delphi method and network analysis process method, and in the third phase of the research, the efficiency of innovative techniques in improving new and traditional performance criteria of ICT fieldcompanies is investigated. According to the results of the present study and in general among 8 sample companies, the first rank of efficiency is awarded to Iran Arqam Company and the 8th rank is awarded to Iran Telecommunication.

1 Introduction

Innovation is one of the basic tools of growth strategies to enter new markets, increase market share and create a competitive advantage. Companies facing increasing competition in global markets are beginning to understand the importance of innovation; because rapidly changing technologies and fierce global competition are rapidly reducing the added value of existing products and services. Therefore, innovation is an essential component of a company's strategies, which have several advantages, including the use of better production processes, better market activity, creating a positive reputation in customer perception, and thus gaining a sustainable competitive advantage.

According to the researches that have been done in the country about the research literature, which among them , the evaluating the impact of customer orientation, innovation on financial performance [5], Innovation and the moderating role of social responsibility on financial performance in various industries [16], market orientation, organizational innovation and competition power on financial

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performance and market performance [8], Market orientation on innovation and financial performance [4], The relationship between innovation in marketing and financial performance [10], can be named which despite domestic researches that has further examined the relationship and impact of financial performance and innovation with each other or other variables and each of them has only examined one or two types of innovations and has not comprehensively examined different types of innovations and different performance indicators, and there is a research gap in this field. In previous researches, different solutions have been presented in this field. Findings from previous researches suggest that organizational innovation, which leads to the renewal or improvement of the administrative and structural sector, facilitates other types of innovation. For example, Damanpour et al. found that administrative innovations lead to technical innovations; Similarly, Staropoli emphasized the importance of organizational restructuring and coordination mechanisms for improving technological innovations in the pharmaceutical industry, while Germain's study showed that organizational structural characteristics may predict significant process innovations in the procurement sector [21, 23, 25]. In this research, based on agency theory , it focuses on identifying and analyzing innovative techniques as an effective and key factor in improving new and traditional performance criteria of companies. It is expected that the results of the present study can provide solutions for innovative market orientation in order to measure the efficiency of innovative techniques in improving new and traditional criteria of companies' performance.

2 A Review of Theoretical Foundations and Research Background

In management accounting, innovation more includes the introduction of quality improvement programs and changes in management accounting, reporting and control systems [37]. Among the theories related to innovation, the new or systematic theory and organizational learning theory with the learner organization can be pointed out that the topic of organizational learning was raised around the 1970s. Peter Sange's famous book, named The Fifth Principle, created reputation and promoting open system thinking and organizational learning, and states that innovation enables companies to better respond to competition, environmental and technological change, and by acquiring new capabilities to achieve better financial performance [22].

With the separation of ownership from management in large corporations, it is possible for managers to make decisions that are in line with their interests and in conflict with the interests of shareholders [28,16], in this case, determining the competitive position of companies and evaluating their performance plays a very important role in the progress of their activities [18]. Ferdinand et al. (2018), in a study entitled Knowledge Management and Market Orientation and Strategic Orientation, Innovation and Performance, evaluated this issue. They stated that the main purpose of this study was to investigate how knowledge management helps to develop strategic orientation and increase innovation and improve organizational performance, and stated that effective knowledge management significantly affects the strategic orientation of companies. There is also no direct relationship between knowledge management and innovation. Navarro et al. (2016) believe that companies use the results of innovation to support economic and social achievements and benefit from economic and social achievements to achieve higher financial performance [22]. It is clear that companies have different levels of innovative capabilities, and innovative activities must be focused in many respects simultaneously including new products, new organizational and marketing practices, or new administrative systems and process technologies [11]. In addition, according to the research of Damanpour and Evan , the balanced rate of acceptance of managerial and technical innovations in helping companies to maintain and improve their performance is more effective than the implementation of each of these innovations alone [21]. Although the innovation literature does not provide a conclusion as to whether a particular type of innovation is likely to have a greater or lesser

impact on company performance, but it can be concluded that each innovation also affect each other and must be integrated [41]. Findings from previous researches suggest that organizational innovation that leads to the renewal or improvement of the administrative and structural sector facilitates other types of innovation. For example, Damanpour et alfound that administrative innovation leads to technical innovation [21]; similarly, Staropoli emphasizes the importance of organizational restructuring and coordination mechanisms for promoting technology innovations in the pharmaceutical industry, while Germain's study showed that organizational structural features may have significant predictions of process innovations in the procurement sector [23, 25]. Recently, in particular, Walker stated that organizational, marketing, and service (or product) innovations are relevant in a study in public organizations, and more researches are needed to clarify these findings [41]. Li et al. study of Chinese companies shows that process and product innovations are significantly correlated [30]. However, recent literature does not provide explicit empirical results on the direction of this relationship. As Miller states that companies are oblivious to organizational or marketing innovations that are essential to the effective growth and efficiency of a company. [32] John and Davis asserted that marketing innovations increase the value of companies by increasing product consumption and making more profit [29]. In the following, researches done inside and outside Iran are pointed out, in which Baghlaniaei et al. showed that among the intervening factors, high inflation, sharp exchange rate fluctuations and inability to supply equipment and required parts from abroad have the greatest impact on the inefficiency of the company's financial performance. [17] Among the strategies, only the lack of international communication has become significant; and among the consequences, the loss of credit, the inability of the company to compete in the industry and the reduction of customers have the greatest impact on the inefficiency of the company's financial performance. Zabol and Abu Nouri found that the realized GARCH models are more accurate both in fitting the performance data and in predicting the conditional variance (turbulence) of the Tehran Stock Exchange index. [1] Kargar and Ghadami to present the innovation model show that capable and knowledgeable customers, supply chain demand and virtual network-based structures have a positive and significant relationship, but the components of intellectual and virtual human integration and the new ownership of capital was not approved due to the lack of appropriate structural and human infrastructure in the registration organization. Finally, the localized model of innovation economy was designed based on the main dimensions of strategy in Iranian government organizations. Mafi and Sadegh Hori in examining the impact of product innovation strategy and process innovation strategy on business performance with the mediating role of environment dynamic and competitiveness, found that the product innovation strategy has a positive effect on business performance through environment dynamic. Product innovation strategy has a positive impact on business performance through environment competitiveness. [14] Process innovation strategy has a positive impact on business performance through environment dynamic. Process innovation strategy has a positive impact on business performance through environment competitiveness. The results , in examining the effect of innovation on the performance of pharmaceutical companies found that the effect of innovation on performance is positive. [15] Rahavi,in evaluating the impact of customer orientation, innovation on the bank's financial performance found that customer orientation has a positive and significant effect on innovation, financial performance and customer subjective image of Bank Saderat. [5] Ahmadi et al. in examining the effect of open innovation on the innovative performance of the company showed that open innovation has a significant effect on the innovative performance of the company, also the moderating role of market turbulence is significant. [1] Namazi and Moghimi, in assessing the impact of innovation and the moderating role of social responsibility on the financial performance of companies show that innovation in the pharmaceutical, chemical and plastic industries than other industries has a greater impact on financial performance. [16] Taleghani, in examining the relationship between knowledge management and organizational

innovation showed that the indicators of knowledge creation, knowledge retention, knowledge transfer and application of knowledge have a significant relationship with organizational innovation and in order to achieve organizational innovation, managers need to integrate knowledge capitals in different sectors and have the knowledge of internal and external forces. [9] On the other hand, knowledge should be distributed throughout the organization. Better distribution of knowledge will increase the likelihood of organizational innovation. Ghasemi et alin examining the role of strategic innovation and open innovation on performance, showed that strategic innovation and open innovation have a significant effect on company performance. Among the dimensions of strategic innovation and open innovation, three dimensions of value innovation, enter to market innovation and sharing of new knowledge and technology had a positive and significant effect on the performance of companies operating in Bushehr Special Economic Zone. [12] Pakdel et al. in evaluating the effect of market orientation, innovation and customer loyalty on performance, found that in Paul Garment Group, increasing the degree of innovation is the result of increasing the level of market orientation and this leads to better innovation performance in the company. The innovative performance result of the company is also an increase in customer loyalty, which ultimately leads to an increase in the level of business performance. [3] HabibiNodeh and Mehrani in examining the impact of market orientation on innovation and financial performance, found that increasing the degree of innovation is a result of increasing the level of market orientation and this in itself leads to better innovation performance in the company; finally, a set of factors directly leads to an increase in financial performance[4]. Taherinia and Souri, in examining the relationship between corporate innovation in marketing and financial performance, show that innovation, except in the debt ratio, which had a negative relationship, had a significant positive relationship on the other aspects of financial performance such as activity ratio, profitability ratio and liquidity ratios [10]. Abroad, Ferdinand et al. in the study of knowledge management and market orientation and strategic orientation, innovation and performance, showed that effective knowledge management is significantly effective in the strategic orientation of companies. [24] There is also no direct relationship between knowledge management and innovation. Wen Wen et alin examining resource constraints, innovation capability and financial fraud showed that innovation capabilities can give managers more confidence and eliminate their tendency to cheat and thus prevent them from participating in fraud, and two human and financial resources constraints are positively associated with the possibility of corporate financial fraud, but these effects can be mitigated by the ability to innovate. [42] Chen et al. in examining the presence of a female representative on the board, corporate innovation and performance found that the presence of a female representative on the board is associated with greater success of innovation and therefore increases the company's performance in industries with increasing innovation. [19] Companies with female executives are more willing to invest in innovation and invest more in research and development costs. In addition, the presence of a female representative on the board has a positive relationship with company performance only for companies in which innovation and creativity have a special role on them. Peter ,in examining the costs of research, development and strategic decisions on the financial performance of small and medium companies believes that in terms of financial performance related to the optimal settings of strategic research and development decision-makings, depends on the size of the company and considered time. [35] The results indicate that the managers of medium-sized companies, by making more use of research activities, in order to increase their medium-term financial performance, consider innovation as effective and necessary within the company. Ramanatan et al. in examining the relationship between innovation and financial performance with respect to the flexibility of environmental regulations, showed clear evidences of a positive and significant role of innovation in firm performance. [36] Innovation plays a more prominent role in company performance when companies are faced with more flexible environmental regulations than when regulations are not flexible. Navarro et al. in their study

of innovation, social and economic responsibilities with financial performance found that companies use the results of innovation to support economic and social achievements and benefit from economic and social achievements to achieve higher financial performance is significant [34]. Solianto,in examining the relationship between market orientation and central learning in improving innovation and performance, believes that market orientation has a positive effect on innovation. Also, learning-orientation itself leads to improve company innovation and ultimately innovation will lead to improve company performance. [39].

Eris and Ouzman (2012), in examining the impact of market orientation, learning-orientation and innovative behavior on business performance, found that market orientation affects the business performance of companies through the effect of learning-orientation and innovative behavior, and market orientation also has a direct impact on company performance. Is. [23] Gandai et al. in evaluating the effects of different types of innovation, identify the relationships between innovations and company performance using an integrated performance analysis and show that different types of innovations have positive effects on company performance [26] In manufacturing industries. Hernandez &Delgado,in their study of the effect of production innovation on financial performance, showed that market-orientation has an influence on innovation on a greater degree. When the environment is uncertain and markets are more turbulent, since market-orientation allows companies to stay in touch with the environment, innovation thus plays a moderating role between market-orientation and performance [27].

3 Research Questions

In this research, according to the aforementioned contents and theoretical foundations of the research, the following questions are raised:

What are the basic and general criteria of innovative techniques?

How is the performance efficiency of ICT companies?

4 Research Methodology

The research design is an inductive design and based on the purpose is an applied research and a related questionnaire was used to collect information related to the test of research questions. It should be noted that this research is quantitative and descriptive, so after identifying the existing factors by Delphi method from the participants, the questionnaire was used as a tool to collectively assess the opinions of experts in the continuation of the research, and a standard questionnaire is not a measure of qualitative relationship. First, to discuss theoretical issues related to each of the models based on library studies, books, dissertations, articles and websites were referred and then to identify the appropriate parameters for using the mentioned models in ICT companies, extraction of all qualitative and quantitative information, it is referred to the procedures, forms, financial statements and performance statistics available in the company. The method of specialized interviews was used to obtain the opinion of university scientific experts who have studied in matters related to the ICT field and managers and experts who work in various positions. The locative domain was the companies listed on the Tehran Stock Exchange during 2013-2017.

From 25 companies in the field of ICT based on the systematic elimination sampling method, 8 companies were selected as a statistical sample.To identify the basic and general evaluation criteria and minor components in the discussion of the efficiency of ICT companies in the first phase through the history of previous researches and Delphi method and distribution of questionnaire and aggregation of opinions of people and in the second phase, the classification of inputs and outputs of the model and

weighting of each parameter with Delphi method and network analysis process method and in the third phase, determining the performance efficiency of ICT companies have been done.

Phase 1: Determining the centers of decision-making units, inputs and outputs of departments in ICT companies

Table 1: Demographic status

percentage	frequency	Demographic status
gender		
33	4	female
67	8	male
age		
9	1	20-30 years
25	3	31-40 years
33	4	41-50 years
33	4	More than 50 years
education		
35	4	Bachelor
50	6	Master
15	2	Ph.D.
Work experience		
8.3	1	Under 10 years
8.3	1	11-15 years
25	3	16-20 years
58.4	7	More than 20 years
8.3	1	Under 10 years
Type of responsibility of area of study		
16.67	2	Manufacturing activities
16.67	2	Information software
25	3	telecommunication
61.68	5	Consulting activities
expertise		
8.4	1	Operation and data (data and network security(
16.6	2	Networked systems and ICT management
25	3	ICT applications (multimedia)
25	3	Mobile and satellite telecommunications
25	3	Optical telecommunication and control of telecommunication systems

4.1 Determination of Parameters

4.1.1 Decision-Making Units

The ICT industry has sub-categories such as: manufacturing activities, information software, telecommunications, consulting, etc., which include the companies listed in Table 2:

Table 2: ICT companies

field of activity	symbol	company
Consulting and software development	Marqam	Iran Arqam
Consulting and software development	Ranfor	Informatics services
Consulting and software development	Medaran	Iranian data processing
Wholesale of electronic equipment and components	Topkish	Parsian Kish E-Commerce
Manufacturer of mobile landlines	Lakma	Iran Telecommunication Factory
Production and distribution of audio and video equipment	Lipam	Payam industrial Co.
Production and distribution of audio and video equipment	Lipars	Pars Electric
Create and explain communication services	Akhayer	Iran Telecommunication

Source: [12]

In Table 2, 8 companies in the ICT industry are used as decision-making units in the data envelopment analysis model.

4.1.2 Model Input Variables

In selecting inputs and outputs in the study with much efforts, 9 inputs were presented as an indicator of the performance of ICT companies, which is presented in Table 3:

Table 3 : Innovative Techniques

row	Innovation types	indices	Measurement manner	source
1	Individual innovation	The level of intellectual property of the company	Number of professional staff to total staff	Thornehl (2006)
2	Environmental innovation	Use of new management accounting methods (activity-based costing, activity-based management, balanced evaluation, goal-based costing, standard costing, quality costing and Kaizen costing)	This index was measured bilaterally. If the company has used any of the new systems, the number is one, otherwise it is zero.	Hajiha and Kharatzadeh (2014) and Johnson and Kaplan (1987)
3	Technical innovation	Acquisition of machinery, equipment and software	Amount of capital for the acquisition of machinery, equipment and software	Roddell, Vance and Sanchez (2016)
4	Executive innovation	Staff training costs	Ratio of education costs to total salary costs	Thornehl (2006), Rodil et al. (2016) and Amara, Pablo, Landley and Delorix (2016)
		Financing costs	Company debt	Thornhall (2006), Rodil et al. (2016¬) and Amara, Pablo, Landley, &Delorex (2016)
		Managerial and technology methods	If the company had used management and technology methods is one, otherwise is zero	Thornhall (2006), Rodil et al. (2016) and Amara, Pablo, Landley, &Delorex (2016(
		Research and development costs	Research and development costs	Thornehl (2006), Rodil et al. (2016) and Amara, Pablo, Landley, &Delorix (2016)
5	Manufacturing innovation	Increase production quality; reduce production costs; Development of innovations for existing products to improve customer use; Development of products with special techniques; Development of products using new materials	If any of the above is achieved, it will be quantitative with One, otherwise it will be quantified by zero number, and finally all the points will be summed for each company.	Gandhi et al. (2011)
6	Process innovation	Determining and eliminating non-value factors; Reduce variable costs (including costs in production processes, techniques, machinery and software); increase output quality; increase delivery speed	If any of the above is achieved, it will be quantitative with One, otherwise it will be quantified by zero number, and finally all the points will be summed for each company.	Gandhi et al. (2011)
7	Marketing innovation	Restructuring of existing or new products (through changes such as appearance, packaging, shape and volume); Renewal of distribution channels; Product upgrade renewal; Renewal of product pricing techniques; Restructuring marketing management	If any of the above is achieved, it will be quantitative with One, otherwise it will be quantified by zero number, and finally all the points will be summed for each company.	Gandhi et al. (2011)
8	Performance innovation	Ability to introduce new products and services to the market before competitors; New products ; New production and service projects; Innovations introduced for work processes; Intellectual innovations; administrative system renewal.	If any of the above is achieved, it will be quantitative with One, otherwise it will be quantified by zero number, and finally all the points will be summed for each company.	Gandhi et al. (2011)

Table 3 : Continue

row	Innovation types	indices	Measurement manner	source
9	Organizational innovation	Renewing the procedures, methods and processes used to run the company in an innovative way; Supply chain management; Reproduction and quality of management systems; Human resource renewal; information system renewal; Restructuring the organization into teamwork; Coordination between different types of sectors such as marketing and production; Organizational restructuring into strategic partnerships and long-term business partnerships	If any of the above is achieved, it will be quantitative with One, otherwise it will be quantified by zero number, and finally all the points will be summed for each company.	Gandhi et al. (2011)

4.1.3 Model Output Variables

Taking into account the indicators of ICT companies, and studies conducted under the supervision of company experts, 7 outputs were presented as indicators of the performance of cities and are presented in Table 4:

Table 4: New and Traditional Performance Criteria

row	Types of performance	indices	Measurement manner	source
1	New performance criteria	Economic value added	EVA= (Capital injected into the project) × (Capital cost - Capital return) Therefore, the operational formula of economic value added is calculated from the following equation: EVA = EBIT ×) 1-t) - WACC × Capital EVA: economic added value; EBIT: operating profit; t: tax rate; WACC: The weighted average cost of capital that can be calculated as follows: WACC = (WS × KS) + (Wd × Kd) The weight of ordinary equity (Ws) is calculated as follows: Ws= Equity book value / Equity book value+ beneficiary debts book value Weight of beneficiary debts (Wd) is calculated as follows: Wd: = book value of all beneficiary debts / Equity book value+ beneficiary debts book value Thus, calculating the WACC rate requires not only the borrowing cost and the rate of return expected by shareholders, but also the weight of each of these components in the capital structure of the business unit. Kd: In this study, the debt cost rate is equal to the average government bond issue rate. To calculate Ks from the discounted cash flow method or the Gordon model, which is as follows: $$K_s = \frac{D(1+g)}{P} + g$$ D = cash profit of each share P= market price of each share g = Dividend growth rate How to calculate g dividend growth rate: g = ROE × Accumulation profit ratio ROE: Return on equity (net profit on equity); Capital: Capital Equity + interest-beneficiary debts (both short-term and long-term) = capital Which has been adjusted to save end-of-service benefits for employees and save taxes Beneficiary debts: includes facilities received from banks and long-term debts.	Moinuddin et al., (2010); Roodpashti et al., (2016)
2		The driving force of economic value added	$$EVA\ Momentum_t = \frac{EVA_t - EVA_{t-1}}{salee_{t-1}}$$:Sales of the company in the previous period EVA Spread : economic value added gap	Roodpashti et al., (2016); Stewart (2009); Diot and Dotoit (2007) and Viravan (2011)

Table 4: Continue

row	Types of performance	indices	Measurement manner	source
3		economic value added gap	$$EVASpread_{t\_Capital} \quad \overline{EVA}$$: Roc: Return on capital (profit before interest and taxes on total capital); EVA: economic added value; Capital: Capital; Wacc: Weighted average cost of capital	Rudpashti et al., (2016); Diot and Dutuit (2007) and Viravan (2011)
4		Market value added	The difference between the market value of the company at the end of the financial year minus the book value of the capital used in it at the end of the period.	Altaf (2016), Iman (2020)
5	Traditional performance criteria	Return on asset rate	Return on asset rate: $\dfrac{net\ profit}{Total\ asset}$	Moinuddinet al., (2010); Shah Alizadeh et al. (2013)
6		Operational cash flow	Operational cash flow at the end of the course	Moinuddin et al (2010).
7		Equity return rate	Equity return rate: $\dfrac{net\ profit}{Total\ asset}$	Moinuddin et al (2010)

Phase 2: Classification of model inputs and outputs and weighting to each parameter.

4.1.4 Selection and Determination of the Weight of the Parameters
Selection of Model Parameters

According to the review of previous texts and researches, factors were counted as performance indicators. Subsequently, Delphi meetings were held with experts, including experts and managers, especially those studied by experts and managers of ICT companies, numbering 12 people and the output of these sessions, including research literature studies, has been the extraction of more than 9 effective factors in the model input and the extraction of more than 7 effective factors in the model output in which the results are presented in Table 5; which these discussions are defined in the first phase of the project.

Manner of criteria relationship with each other

In this section, the identified criteria are placed in two clusters. Also, the network of criteria and the effectiveness of the criteria on each other as well as the amount of effects are shown in Table 5:

Table 5 : Manner of Relationship of Research Criteria

input	output
Cluster one (model input variables): The first element is the total number of employees, the second element is environmental innovation, the third element is technical innovation, the fourth element is executive innovation (company operating costs), the fifth element is production innovation, the sixth element is process innovation, the seventh element is marketing innovation, the eighth element is performance innovation and element Ninth is Organizational Innovation	Cluster Two (model output variables): The first element is market value added, the second element is economic value added, the third element is economic value added gap, the fourth element is market value added, the fifth element is company total assets, the sixth element is operating cash flow and the seventh element is equity

Weight of criteria

In the network analysis process method, using the network of relationships between model variables, we compile a table of pairwise comparisons of criteria. According to the opinion of 12 experts of the organization, especially in the case of the relevant ICT industry in each of the indicators collected through a questionnaire, they were asked to express the degree of importance of each criterion to the other. (To combine the opinions of experts, we must first calculate the compatibility rate of the tables and then use the geometric mean to combine the opinions of experts. Calculations have been done with

Microsoft Excel software on a case-by-case basis and the complete solution of the model has been made with Super Decision software that after extracting the information from the pairwise comparison table, the arithmetic mean of the opinions of the individuals was taken so that for each unit, the opinions of the individuals were added separately and multiplied by one twelfth. It should be noted that the weight of all respondents is considered as the same; the results given in Table 6:

Table 6: Average Opinions of People for Weighting Input Parameters

	Total number of employees of the company	Environmental innovation	Technical innovation	Sum of company costs	Manufacturing innovation	Process innovation	Marketing innovation	Performance innovation	Organizational innovation
Total number of employees of the company	1.0000	2.0038	3.3056	1.5953	2.3649	0.5633	2.0072	2.0072	2.0072
Environmental innovation	0.4990	1.0000	0.7030	1.8750	0.6583	1.1456	1.8542	1.8542	1.8542
Technical innovation	0.3025	1.4225	1.0000	0.8542	1.5521	2.1388	1.3438	1.8854	1.8854
Sum of company costs	0.6269	0.5333	1.1707	1.0000	2.8750	3.0104	2.7083	2.1667	2.7604
Manufacturing innovation	0.4228	1.5190	0.6443	0.3478	1.0000	2.1369	0.8713	1.4611	2.3981
Process innovation	1.7754	0.8729	0.4675	0.3322	0.4680	1.0000	1.1250	1.9814	1.9097
Marketing innovation	0.4982	0.5393	0.7442	0.3692	1.1477	0.8889	1.0000	2.1666	2.0972
Performance innovation	0.4982	0.5393	0.5304	0.4615	0.6844	0.5047	0.4616	1.0000	2.6388
Organizational innovation	0.4982	0.5393	0.5304	0.3623	0.5237	0.5237	0.4768	0.3790	1.0000

In the next step, the matrix of pairwise comparisons should be normalized, so a geometric mean is taken on the line, so that for each level it is multiplied separately and reaches the exponent of one third, in the last step to determine their weight and priority, on the sum of the geometric mean, normalization takes place, they are prioritized from more weight to less, which is given in Table 7:

Table 7: Prioritization of Model Input Parameters

Prioritization of model input parameters	Geometric mean	weights	Prioritization
Total number of employees of the company	1.6923	0.1764	1
Environmental innovation	1.1365	0.1185	4
Technical innovation	1.2164	0.1268	3
Sum of company costs	1.5605	0.1626	2
Manufacturing innovation	0.9930	0.1035	5
Process innovation	0.9216	0.0961	6
Marketing innovation	0.8877	0.0925	7
Performance innovation	0.6713	0.0700	8
Organizational innovation	0.5152	0.0537	9
Sum.	9.5944	1.0000	-

According to the tests performed, the compatibility index is obtained from model (1):

$$CI = (9.8430 - 9) / 9 = 0.0937 \tag{1}$$
$$CR = 0.0937 / 1.45 = 0.0646 < 0.1$$

Also, after extracting the information from the pairwise comparison table for the output parameters, the arithmetic mean of the people's opinions was taken, so that for each unit, the opinions of the people

were added separately and multiplied by one twelfth. It must be mentioned that the weight of all respondents are considered the same, the results are given in Table 8:

Table 8: Mean Opinions of People for Weighting Output Parameters

Average opinions of people for weighting output parameters	Economic value added	The driving force of economic value added	Economic value added gap	Market value added	Return on asset ratio	Operational cash flow	equity
Economic value added	1.0000	2.0565	2.9953	1.5953	0.4666	2.1903	0.8097
The driving force of economic value added	0.4863	1.0000	1.1697	1.8750	0.6583	1.5947	0.3933
Economic value added gap	0.3339	0.8549	1.0000	0.8542	1.6771	2.8472	0.3207
Satisfaction of senior officials of the organization	0.6269	0.5333	1.1707	1.0000	0.9980	1.8542	0.6584
Return on asset ratio	2.1432	1.5190	0.5963	1.0020	1.0000	3.0212	1.5694
Operational cash flow	0.4566	0.6271	0.3512	0.5393	0.3310	1.0000	1.2228
equity	1.2351	2.5424	3.1185	1.5188	0.6372	0.8178	1.0000

In the next step, the matrix of pairwise comparisons should be normalized, so a geometric mean is taken on the line, so that for each level it is multiplied separately and reaches the exponent of one third, in the last step to determine their weight and priority on the sum of the geometric mean, normalization takes place and are prioritized from more to less weight, which is given in Table 9

Table 9: Prioritization of Model Output Parameters

Prioritization of model output parameters	Geometric mean	weights	prioritization
Economic value added	1.3490	0.1848	2
The driving force of economic value added	0.8894	0.1218	5
Economic value added gap	0.8687	0.1190	6
Market value added	0.8996	0.1232	4
Return on asset ratio	1.3735	0.1882	1
Operational cash flow	0.5795	0.0794	7
equity	1.3398	0.1835	3
Sum	7.2996	1.0000	-

Also, the compatibility index is obtained from model (2):

$$CI = (7.7888 - 7) / 7 = 0.1127 \tag{2}$$
$$CR = 0.1127 / 1.30 = 0.0867 < 0.1$$

This ratio is less than 0.1, which indicates consistency in the comparisons, and the obtained weights can be used for the next steps and placed in the super matrix. After obtaining the weights through the pairwise comparison matrices, the special vector obtained from each matrix representing its weight is placed in the mean super matrix and the communication network super matrix can be seen in Table 10

Table 10: Mean Super Matrix - Big Matrix (mean)

	I1	I2	I3	I4	I5	I6	I7	I8	I9
I1	0.0654	0.0654	0.0654	0.0654	0.0654	0.0654	0.0654	0.0654	0.0654
I2	0.0621	0.0621	0.0621	0.0621	0.0621	0.0621	0.0621	0.0621	0.0621
I3	0.0626	0.0626	0.0626	0.0626	0.0626	0.0626	0.0626	0.0626	0.0626
I4	0.0646	0.0646	0.0646	0.0646	0.0646	0.0646	0.0646	0.0646	0.0646
I5	0.0613	0.0613	0.0613	0.0613	0.0613	0.0613	0.0613	0.0613	0.0613
I6	0.0609	0.0609	0.0609	0.0609	0.0609	0.0609	0.0609	0.0609	0.0609
I7	0.0607	0.0607	0.0607	0.0607	0.0607	0.0607	0.0607	0.0607	0.0607
I8	0.0594	0.0594	0.0594	0.0594	0.0594	0.0594	0.0594	0.0594	0.0594
I9	0.0585	0.0585	0.0585	0.0585	0.0585	0.0585	0.0585	0.0585	0.0585
O1	0.0658	0.0658	0.0658	0.0658	0.0658	0.0658	0.0658	0.0658	0.0658
O2	0.0623	0.0623	0.0623	0.0623	0.0623	0.0623	0.0623	0.0623	0.0623
O3	0.0622	0.0622	0.0622	0.0622	0.0622	0.0622	0.0622	0.0622	0.0622
O4	0.0624	0.0624	0.0624	0.0624	0.0624	0.0624	0.0624	0.0624	0.0624
O5	0.0660	0.0660	0.0660	0.0660	0.0660	0.0660	0.0660	0.0660	0.0660
O6	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600
O7	0.0658	0.0658	0.0658	0.0658	0.0658	0.0658	0.0658	0.0658	0.0658

	O1	O2	O3	O4	O5	O6	O7
I1	0.0654	0.0654	0.0654	0.0654	0.0654	0.0654	0.0654
I2	0.0621	0.0621	0.0621	0.0621	0.0621	0.0621	0.0621
I3	0.0626	0.0626	0.0626	0.0626	0.0626	0.0626	0.0626
I4	0.0646	0.0646	0.0646	0.0646	0.0646	0.0646	0.0646
I5	0.0613	0.0613	0.0613	0.0613	0.0613	0.0613	0.0613
I6	0.0609	0.0609	0.0609	0.0609	0.0609	0.0609	0.0609
I7	0.0607	0.0607	0.0607	0.0607	0.0607	0.0607	0.0607
I8	0.0594	0.0594	0.0594	0.0594	0.0594	0.0594	0.0594
I9	0.0585	0.0585	0.0585	0.0585	0.0585	0.0585	0.0585
O1	0.0658	0.0658	0.0658	0.0658	0.0658	0.0658	0.0658
O2	0.0623	0.0623	0.0623	0.0623	0.0623	0.0623	0.0623
O3	0.0622	0.0622	0.0622	0.0622	0.0622	0.0622	0.0622
O4	0.0624	0.0624	0.0624	0.0624	0.0624	0.0624	0.0624
O5	0.0660	0.0660	0.0660	0.0660	0.0660	0.0660	0.0660
O6	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600
O7	0.0658	0.0658	0.0658	0.0658	0.0658	0.0658	0.0658

By implementing the ranking in main cell, and ranking determination from parameters, five parameters with highest points are selected which the results are presented in Table 11.

Table 11: Variables Used in the Model at the End of Fiscal Year

Variables used in the model	row
Total number of company employees	1
Sum of company costs	2
Market value added	3
Company total assets	4
equity	5

Phase 3: Implementation of data envelopment analysis models for definitive data of 2013-2017 and final conclusion

Formation of data envelopment analysis models

After determining the input and output variables, their weights and collecting the needed relevant data, in order to obtain relative efficiency and determine the prioritization of the studied units, the data

envelopment analysis model was used and the results of each are examined for the next steps and presented in Table 12.

Table 12 : Results of Solving the Model of All Units and the Final Ranking with the Entropy Model

Final Rank	Entropy	96	95	94	93	92	DMU	No/
1	0/2589	1	1	1	1	1	Iran Arqam	01
4	0/0794	0/7869	0/5221	0/2298	0/2966	0/4048	Pars Electric	02
7	0/0516	0/6027	0/6421	0/2242	0/1596	0/1638	Parsian E-commerce	03
6	0/0669	0/8047	0/4379	0/2429	0/2501	0/2575	Informatics services	04
2	0/2556	1	1	1	0/9831	0/9623	Iran data processing	05
5	0/0725	1	1	0/1578	0/0951	0/7192	Payam industrial	06
8	0/0188	1	0/6436	0/0587	0/0381	0/0554	Iran telecommunication	07
3	0/1963	1	1	0/7889	0/6326	0/9124	Iran Arqam	08

Since the research model has been used for 5 consecutive years and the efficiency of each decision-making unit has been calculated in each year, the Shannon entropy method has been used to aggregate the efficiency of each unit during 5 years. Shannon entropy method has been used as one of the most famous methods for calculating the weights of indices. Shannon 's concept of entropy plays an important role in information theory. This concept has been developed in various scientific fields, including physics, social sciences and so on. In information theory, entropy is the measurement of the amount of information needed to describe a random variable.

5 Discussion and Conclusion

This research has been a test to identify and prioritize the efficiency of ICT companies according to the inputs and outputs of innovative performance and in general, the findings of the present study can be summarized according to the hypotheses as follows; Iran Arqam unit has been obtained as the most efficient unit by gaining the efficiency rank of one in five consecutive years. In such a way that it has made the desired outputs from the amount of capabilities it had as input. Iran Data Processing Unit and Iran Arqam Unit were close to the efficiency limit in the first two years and three years, respectively, and in the last years of the study, they obtained the efficiency rank One. In such a way that it has made the desired outputs from the amount of capabilities that it had as input. Hence, with the entropy model, they have achieved efficiency as the second and third units of the efficiency acquisition process. Payam industrial unit has the One efficiency rank compared to Pars Electric unit although at the last two examined years, have the efficiency rank One but in the entropy model studied and analyzing its scoring process, Pars Electric unit has the fourth final rank and Payam industrial unit has the fifth efficiency rating. Informatics, Parsian e-commerce and Iran Telecommunication services units with the final entropy model are ranked as sixth, seventh and eighth. In general, as it was said, among the 8 sample companies, the first rank of efficiency is awarded to Iran Arqam Company and the 8th rank is awarded to Iran Telecommunication.

Innovation theories (new or system theory and organizational learning theory or learner organization) show that innovation enables companies to better respond to competition, environmental and technological changes, and by achieving new capabilities to access to better financial performance; but this performance, according to the theory of appropriateness, also depends on various factors, including the type of industry; a new or systematic theory governing the organization or organic pattern that Burns and Stalker[18] called it as organic design or living design. This model places a lot of emphasis on innovation creation to improve the quality of goods and services; the organizational learning theory or learner organization that has emerged in the process of systemic theory, considers the organization as thoughtful and alive. In this theory, the main axis is creativity and innovation. If organizations and managers want to survive and succeed in the long run, they must continuously and consistently adapt

themselves to new situations and innovate. The results of the present study are directly and indirectly consistent with the results of Ramanathan et al. Peter Ferdinand et al. Ghasemi et al. Ahmadi et al. Nejat and Firoozi. Aghighi Therefore, the results of this study are consistent with the findings reported in developed countries. According to the results of the present study, it is suggested that managers, investors and Tehran Stock Exchange seek innovation, especially personal and executive innovation along with the implementation of new management accounting methods to increase profitability, better performance and more market returns of companies; the Tehran Stock Exchange is also suggested to require the disclosure the innovative techniques indices of companies and the related points for the companies listed on the Stock Exchange; it is also suggested that with more careful planning, production lines and supply chain be designed and used in such a way that the organization can have the appropriate flexibility to produce products with newer features; finally, it is suggested that some teams are formed to analyze the reasons for failure and even the success of the production of a particular product or project and the results of the studies of this specialized team are made available to the employees of the relevant departments. Innovation in today's world is an impossible necessity in the growth and development of businesses and market superiority. According to the results of the research questions, it is suggested that the companies studied in this research increase their investment in the field of innovation and include a share in their budget for this purpose every year and according to the results of research questions and the unique role of skilled and creative manpower in the process of developing innovation and creating new values for the companies under study, it is suggested that human resources processes, including the process of selection, recruitment in these companies be reviewed and re-engineered.

Researchers are encouraged to explore the following topics in their future research:

Future researchers are also suggested to model innovation and implement innovation for different companies in various industries and to study and analyze the impact of innovation. Also, this research should be done as a comparison between organizations.

Examine the barriers to non-acceptance of management accounting innovation implementation such as activity-based costing, total quality management, target costing, balanced evaluation, etc. to identify these barriers to take the necessary measures to eliminate them.

It is suggested to esteemed management accounting researchers in Iran to proceed in order to analyze and also apply innovative management accounting techniques (environmental innovation) and their impact in practice. In this regard, special attention should be paid to the cultural and operational contexts of the techniques in such a way that they can answer practical issues and problems in Iran. This requires that Iranian industries and organizations be equipped with new management accounting techniques as soon as possible and apply them in practice.

The most important limitation of the present study is the lack of full disclosure of information related to research variables. Information on all research variables is not fully available for listed companies. Therefore, to avoid biasing the research results, some company-years were removed from the statistical sample and this reduced the sample size.

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