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Analyzing and Ranking the Indices of Innovation Model in Food Products

Ramzan Gholami Avati[a,*], Mohammad Mehdi Parhizgar[b], Mohammad Taghi Amini[b], Mohammad Mahmoudi Meymand[b]

[a] PhD Student, Department of Management, Payame Noor University, P.O. Box 19395-3697, Tehran, IRAN.
[b] Associate Professor, Department of Management, Payame Noor University, P.O. Box 19395-3697, Tehran, IRAN.

ABSTRACT
In the era of knowledge-based economy, rapidly changing and uncertain business environment, means that the company's biggest challenge. Confrontation with the problem of how to exploit the current market, achieve a competitive advantage. Some researchs suggest that innovation is the most important tool for companies to maintain a competitive advantage from the use. For this purpose, what this research seeks to measure the pattern is innovation. The population of the research staff collected food and roses. 2250 people who use formula cochran sample of 250 individuals were determined. Direction Determine the reliability of the composite reliability 0.92 was used. Factor analysis was used to test the validity of the questionnaire. Using structural equation modeling software to analyze the data lisrel and PLS. Results showed that the pattern Innovation evaluation model was perfect, and indicators needed to measure innovation in the field of research and development and investment 8In knowledge, human resources, innovation policies, performance, innovation, technology and the associated information Global flows Global economy, and productivity and trade classifications, and it was determined that the effect of each of the indicators is positive.

KEYWORDS
innovation, business and productivity, innovation performance, research and development

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Introduction

Innovation, as one of the key factors that has a long-term impact on company success in competitive markets (Naranjo-Valenciaa et al., 2015), is undoubtedly one of the most important strategic levers available to a company (Pirastefard, 2001) and a complex process that often involves multiple factors and relationships (OECD, 2013). The innovation process links the project,

CORRESPONDENCE Ramzan Gholami Avati ✉ r_gholami@pnu.ac.ir

invention, development, and transfer of technology with each other. In each of these steps, ideas and concepts are created. But the innovation process is realized when these steps eventually lead to the exploitation and commercialization of a product, process, or more advanced system. The key stages of the innovation process are usually defined within the framework of a project, because this type of organization - which has been widely used since the 1980s onwards - is a more effective method. Each innovation project usually starts with an idea that often involves a technical solution for the customer's current or future needs. After proposing the idea, there is a resource search phase for the idea to come true. Any idea, depending on its complexity, may require several days to several years to flourish. This stage of flourishing ideas is called product development. When a product is developed, it is decided to produce and supply it, and then further development may be required (product improvement, etc.) (Nazarizadeh, 2003). One of the teachings of new research on innovation is that innovation is a very widespread phenomenon. For example, the new distribution system, which was combined with mass production in the United States in a century ago, was one of the most important innovations in the new era (Fagerberge, 2004). Another characteristic of innovation is its inclusiveness. That is, it's not that innovation is dedicated only to a specific group of advanced-technology industries (Malerba, 2004). In fact, innovation suggests a tendency to deny and abandon old habits and try out untested ideas (Menguc and Auh, 2006). To this end, given the increasing complexity of today's world, the constant and rapid transformation, the growing trend of technology and competitive competition in various industries and organizations, the coordination and adaptation of organizations with this complex and variable environment and guaranteeing the survival of organizations needs a change in the organization and technology, the supply of new products and services, which is achieved through innovation and entrepreneurship. Accordingly, leveling enterprise-level innovation indicators is required to decide on the amount of resource allocation to innovation activities and to select areas where innovation is promising high economic returns, as well as management of inter-organizational innovation strategies (Archibugi & Pianta, 1996).

In this regard, in the transition to a new era, food industries inevitably need a defense strategy for the high rate of innovation in responding to environmental needs and requirements. Because these are innovations that can thwart new threats. To this end, by measuring and leveling the factors influencing innovation in the food industry, an important step can be taken to increase the coordination and adaptation to a complex and variable environment. Accordingly, leveling factors influencing innovation in the production of products in the field of innovation development activities, as well as monitoring and evaluating their results as one of the main components of effective innovation policies in order to achieve the goals help the planners for the formulation of proper programs. As the aforementioned documents show, conducting research on the leveling of innovation indices in the food industry in order to exploit its benefits in society can well be a justification for the present research problem. The purpose of this research is to study the leveling of innovation indices in the field of food industry, and the conceptual model used in relation to the review of related literature is the framework of the Organization for Economic Cooperation and Development. In this framework, innovation indices are divided into nine areas of R & D and investment in knowledge, human resources, innovation policies, innovation performance, information and communication technology, specific technologies, globalization, global economic trends and productivity and trade. Accordingly, in the present research, the main question that will be answered is “how is the leveling of factors influencing innovation in the production of products in Jamm and Roze Talayi food industry group using the ISM technique?”

Research background

In a study entitled “investigating the effect of market orientation on product innovation in manufacturing companies of Sanandaj Industrial Township,” Hajipour et al. (2013) concluded that market orientation factors that include creation and dissemination of information, customer orientation, and rivalry can affect product innovation. Jafari et al. (2014) investigated “the impact of organizational innovation on product innovation, market performance, and innovative performance of companies”. Their research findings show that organizational innovation has a significant effect on product innovation, market performance and innovative performance of the company. Karshenas and Garousi Mokhtarzadeh (2015) in a study on “investigating the effect of technological and non-technological environmental opportunities on product innovation and firm process” show the positive impact of industrial technological opportunities on the innovative product-driven performance of the firm as well as the innovative process-driven performance of the firm. This does not hold true for non-industrial technological opportunities, while the positive impact of non-industrial technological opportunities has been confirmed on the innovative process-driven performance of the firm. Ghasemiyeh and Hashemi (2015) carried out a study entitled “identifying and measuring the relationships between the variables affecting innovation in industrial companies using fuzzy DEMATEL technique” and identified 26 variables that influenced innovation in industrial companies in Bushehr province, and then reduced these variables to seven important variables using the fuzzy network analysis process that included change culture in employees, management performance, customer satisfaction, financial conditions, product flexibility, use of new technologies and government support. Finally, the effect and impact of these seven variables were investigated using Fuzzy DEMATEL Technique. The results of their research showed that the variable of change culture in employees is one of the barriers of innovation in the petrochemical companies of Bushehr province. Bi et al. (2016) conducted a research entitled “innovation performance and influencing factors of technological innovation". Their research results show that the innovative performance of low-carbon technology varies among the various manufacturing industries in China. In addition, government laws and regulations, among the three main influencing factors, have a positive impact on the innovative performance of low-carbon technology, which, of course, has a weak and low impact. Technology pressure has a negative impact on the innovative performance of low-carbon technology, and the impact of market elasticity on the innovative performance of low-carbon technology is not irrelevant. Tomlinson (2010) conducted a study entitled as "cooperative ties and innovation" and explored the relationship between cooperative ties and innovation in the UK industry. In his research, he integrated the technological innovation with process and product innovation, and showed that there is a positive and significant relationship between the cooperation within the companies and the innovative performance. In an article entitled "design-based innovation for manufacturing firm success in high-cost operating environments," Roos (2016) states that the manufacturing sector is increasingly looking for innovation to ensure performance growth, especially in high-cost operating environments in order to achieve non-price competition. In addition to examining the legal, technical, and developmental trends of production, he examines the changing balance between the centralized and non-centralized forces of the global supply chain and how the organizations themselves are changing. He states that the pattern of design-based innovation in the manufacturing industry is on the rise, but its advantage can be maximized when integrated with other triple value creation approaches. Beynon et al. (2016) carried out a study entitled "country-level investigation of innovation investment in manufacturing" and used the country-level data set and data on active manufacturing companies in the field of innovation in 47 countries to analyze the relationship between actual implementation of innovation and its principles and records. They examined the relationship between the various stimuli of innovation and the market share in innovation through fuzzy qualitative comparative analysis (fsQCA). In this study, various sets of status variables are considered and examined, the significance of each variable in causal relationships is identified and provides an understanding of the various stimuli of market innovation between sets of countries. Yamamoto and Bellgran (2013) conducted a study entitled as "four types of manufacturing process innovation and their managerial concerns" and present managers' expectations of and preparation for any innovation in the production process. The base strategic objectives are discussed in terms of the type of innovation in the production process that can be carried out in a particular organization. Four types of manufacturing process innovation have been developed by reviewing literature on various research fields, such as production strategy, process innovation, organizational innovation, typology of innovation and new product development. Vega-Jurado et al. (2008) conducted a study entitled as "the effect of external and internal factors on firms' product innovation" and analyzed the effect of internal and external factors on product innovation and how this effect varies in each industry. They estimate three economic models to determine the individual effects of these factors, their common descriptive power and the interactive effects between them. The results show that organizational technical competencies derived from intra-organizational R & D are the main determinants of product innovation. Wang et al. (2008) analyzed information from 71 companies in Singapore in order to analyze the relationship between innovation and the six other determinants. Their research results show an important and positive link between innovation and 1) decentralized structure, 2) human resources, 3) belief in the importance of innovation, 4) risk acceptance, 5) and tendency to exchange ideas.

Research methodology

The present study is applied in terms of its objective and it is descriptive and survey in terms of its methodology. The statistical population of this research is Jaam Roze Talayi food industries group. According to the research objective, topic, as well as its methodology, the most important tool for data collection in order to test the questions in the present study is a paired comparison questionnaire. Much of the data and information necessary for analyzing questions and testing assumptions were gathered by collecting field data from the subjects using a questionnaire. Therefore, the final questionnaires have been submitted to the experts in person. The research expert population in this study includes the experts and managers of Jamm and Roze Talayi food manufacturing and packaging group, i.e. 21 people. Of the distributed questionnaires among the experts, 11 completed questionnaires are mathematically analyzed. Also, in order to plan for the implementation of this research, various conceptual models can be used. In this research, the three-dimensional analytical tool has been used as a conceptual model of the research dimensions. This research tool has three basic dimensions of context, content and structure. The three-dimensional model is based on the idea that each phenomenon can be analyzed in the form of three dimensions of structure, content and context. The conceptual model or theoretical framework of the dimensions of the present research is taken from numerous studies, which are fully presented in the table below.

Table 1. Conceptual model of factors affecting production innovation

	Factors affecting production innovation		
Innovation	Structure	Content-behavior	Context
Focus of process	Specific technologies	Research and development	ICT
Focus of product	Innovation policies	Investment in knowledge	Knowledge and technology globalization
	Innovation performance	Human resources	Global economic trends
		Business and productivity	

In order to analyze the data, the interpretive structural equations method is first used. This method first identifies the effective and fundamental factors and then, using the method presented, presents the relationships between these factors and the way to achieve progress by these factors. By analyzing the criteria at several different levels, the ISM method analyzes the relationship between indices. The interpretive structural model can determine the relationship between the indices that are individually or grouply dependent on each other. The ISM method analyzes the relationship between indices by decomposing the criteria at several different levels. For this purpose, the main research question is: how is the leveling of factors influencing innovation in the production of products in Jamm and Roze Talayi food industry group using the ISM technique?

Research findings

The results of the descriptive tests of respondents showed that 55% of the respondents were men. All respondents aged between 30 and 40. Also, 64% of respondents had a bachelor's degree. In order to achieve all direct and indirect relationships between the research components in accordance with the steps of the ISM method, first, the direct internal connections between the system components should be entered in the initial reachability matrix and the conceptual communication matrix between the variables (Dij) should be formed. In the present study, due to the number of experts and the diversity of views, the binary relationship between these variables was investigated using the following scale: V: The factor i (row) can be the basis for reaching the factor j (column). X: There is a two-way relationship between the factor i (row) and the factor j (column). A: The factor j (column) can be the basis for reaching the factor i (row). O: There is no relationship between factor j (column) and factor i (row).

A questionnaire was distributed among 11 experts. Since in this research 11 experts were used to complete the questionnaires, mode based on the highest frequency in each stratum was used to formulate the interactive matrix. Finally, results are presented in the table below:

Table 2. Summary of experts' opinions

	1	2	3	4	5	6	7	8
1. ICT		V	V	A	A	V	V	A
2. Globalization of knowledge and technology			V	A	A	V	V	V
3. R&D and investment in knowledge				A	A	X	X	A
4. Global economic trends					O	V	V	O
5. Innovation policies						V	V	V
6. Business and productivity							X	A
7. Innovation performance								A
8. Human resources								

The reachability matrix is obtained by determining relations as zero and one on the matrix obtained in the previous step: if the input (i, j) (the intersection of row i and column j) is in structural self-interacting matrix v, then 1 is given to the input (i, j) in the reachability matrix and zero is given to the input (j, i). If the input (i, j) is in structural self-interacting matrix A, then 0 is given to input (i, j) in the reachability matrix and 1 is given to the input (j, i). If the input (i, j) is in structural self-interacting matrix X, then 1 is given to the input (i, j) in the reachability matrix and 0 is given to the input (j, i). If the input (i, j) is in structural self-interacting matrix o, then 0 is given to the input (i, j) in the reachability matrix and 1 is given to the input (j, i). Based on the above rules, the reachability matrix is obtained from self-interacting matrix transformation to a two-value matrix (zero-one). To extract the reachability matrix, replace the V and X with the number one in each row, and replace the A and O with the number zero in self-interactive matrix. After converting all rows, the result is called the initial reachability matrix. Then, the secondary relations between dimensions are controlled. The table below shows the results of a structural self-interactive matrix.

Table 3. Initial reachability matrix (Dij)

	1	2	3	4	5	6	7	8
1. ICT	1	1	1	0	0	1	1	0
2. Globalization of knowledge and technology	0	1	1	0	0	1	1	1
3. R&D and investment in knowledge	0	0	1	0	0	1	1	0
4. Global economic trends	1	1	1	1	0	1	1	0
5. Innovation policies	1	1	1	0	1	1	1	1
6. Business and productivity	0	0	1	0	0	1	1	0
7. Innovation performance	0	0	1	0	0	1	1	0
8. Human resources	1	0	1	0	0	1	1	1

In the second step, the matrix obtained in the first step is added to the unit matrix, and the initial reachability matrix is obtained. Then, the final reachability matrix is obtained. In fact, once the initial reachability matrix is obtained, there must be internal consistency. For example, if factor 1 leads to factor 2 and factor 2 leads to factor 3, factor 1 also leads to factor 3, and if this relationship does not hold true in the initial reachability matrix, the matrix should be modified and the relationships that have been missed must be replaced. In the final reachability matrix, components marked with * are indicative of the existence of an indirect relationship between the two corresponding components.

Table 4. Final reachability matrix (Tij)

	1	2	3	4	5	6	7	8
1. ICT	1	1	1	0	0	1	1	1*
2. Globalization of knowledge and technology	1*	1	1	0	0	1	1	1
3. R&D and investment in knowledge	0	0	1	0	0	1	1	0
4. Global economic trends	1	1	1	1	0	1	1	1*
5. Innovation policies	1	1	1	0	1	1	1	1
6. Business and productivity	0	0	1	0	0	1	1	0
7. Innovation performance	0	0	1	0	0	1	1	0
8. Human resources	1	1*	1	0	0	1	1	1

To determine the level and priority of the variables, the set of reachability and the set of prerequisites are determined for each factor. The set of reachability of each factor includes the factors that can be achieved through this factor and the set of prerequisites includes the factors through which these factors can be achieved. This is done using the reachability matrix. After determining the reachability matrix and the prerequisite for each factor, common elements are identified in the reachability set and the prerequisite set for each factor. After determining these sets, it is time to determine the level of elements (factors). The level of elements means whether factors affect other factors or are affected by other factors. Factors that are at the highest level (Level 1) are influenced by other factors and do not affect the other factor. In the first table, the factor in which the reachability set and its common elements are exactly the same is in the highest level. After determining this factor or factors, they will be deleted from the table and the next table will be formed with other remaining elements. In the second table, as in the first table, the second level factor is determined. These factors affect the level one and are themselves influenced by level three factors. This will be continued till determining the level of all factors.

Table 5. Determining the first level of dimensions in ISM hierarchy

Variables	Input set	Output set	Common set	Level
1. ICT	1,2, 4, 5, 8	1, 2, 3, 6, 7, 8	1, 2, 8	
2. Globalization of knowledge and technology	1,2, 4, 5, 8	1, 2, 3, 6, 7, 8	1, 2, 8	
3. R&D and investment in knowledge	1, 2, 3, 4, 5, 6, 7, 8	3, 6, 7	3, 6, 7	1
4. Global economic trends	4	1, 2, 3, 4, 6, 7, 8	4	
5. Innovation policies	5	1, 2, 3, 6, 7, 8	5	
6. Business and productivity	1, 2, 3, 4, 5, 6, 7, 8	3, 6, 7	3, 6, 7	1
7. Innovation performance	1, 2, 3, 4, 5, 6, 7, 8	3, 6, 7	3, 6, 7	1
8. Human resources	1,2, 4, 5, 8	1, 2, 3, 6, 7, 8	1, 2, 8	

Table 6. Determining the second level of dimensions in ISM hierarchy

Variables	Input set	Output set	Common set	Level
1. ICT	1,2, 4, 5, 8	1, 2, 8	1, 2, 8	2
2. Globalization of knowledge and technology	1,2, 4, 5, 8	1, 2, 8	1, 2, 8	2
4. Global economic trends	4	1, 2, 4, 8	4	
5. Innovation policies	5	1, 2, 5, 8	5	
8. Human resources	1,2, 4, 5, 8	1, 2, 8	1, 2, 8	2

Table 7. Determining the third level of dimensions in ISM hierarchy

Variables	Input set	Output set	Common set	Level
4. Global economic trends	4	4	4	3
5. Innovation policies	5	5	5	3

Now, after determining the relationships and levels of variables, they can be mapped into a model.

The components of high levels are greatly influenced and lower levels are the most effective components of the system. The intermediate levels also contain components that have a degree of interconnection of affecting and being affected by other components of the system (dependent on component level). In this study, variables have been identified at three levels. At the highest level, the components of innovation performance, business and productivity, and R & D and investment in knowledge are greatly affected. The components of communication and information technology, science and technology globalization, and human resources are in the second level. At the lowest level, the components of global economic trends and innovation policies are placed that are most effective. In order to analyze the obtained model, the driving power-dependence analysis method (MICMAC chart) is used.

The sum of the values of rows in the final reachability matrix for each element indicates the degree of driving power and the sum of the values of columns indicates the degree of dependence. Factors that are at lower levels of the model are considered to be leading factors because of their driving power and factors that are at higher levels are considered to be following factor because of their dependence on leading factors. Based on the driving power and dependence, four groups of identifiable elements will be:

1. Autonomous: Factors that have weak driving power and dependence power.

2. Dependent: Factors that have low driving power, but strong dependence.

3. Connected: Factors that have strong driving power and dependence power.

4. Independent: Factors that have strong driving power, but weak dependence power.

In fact, this method is used to analyze the findings with the aim of identifying the degree of dependence and driving power of the system elements in structural analysis. Thus, the sum of the rows of the number of relationships (including the direct and indirect relationships identified for each component) in the final reachability matrix indicates the degree of driving power of that component, and the sum of the columns of the number of direct and indirect relations in the matrix of the table indicates the degree of dependence of that component.

Table 8. Dependence-driving table

Variables and dependence	1. ICT	2. Globalization of knowledge and technology	3. R&D and investment in knowledge	4. Global economic trends	5. Innovation policies	6. Business and productivity	7. Innovation performance	8. Human resources
Abbreviation	A	B	C	D	E	F	G	H
Driving power	6	6	3	7	7	3	3	6
Dependence	5	5	8	1	1	8	8	5
Level	2	2	1	3	3	1	1	2

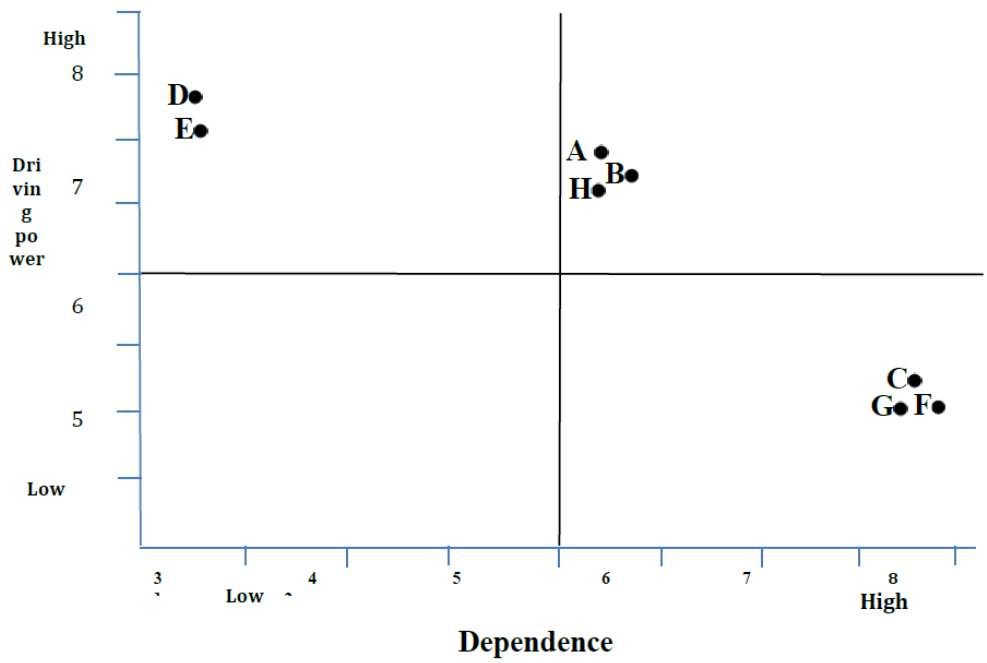

Figure 1. Analysis of driving power-dependence

In the analysis of driving power-dependence, variables were classified into four categories in terms of the driving power and dependence. The first category consists of autonomous variables with weak driving power and dependence. These variables are relatively non-connected to the system and have low and weak connections with the system. In this study, no variables are included in this category.

In the second group, there are dependent system components that have low driving power, but are strongly dependent. These components, which have the highest power of dependence and the lowest driving power in the system, are R & D and investment in knowledge, business and productivity, and innovation performance. The third category is the connected variables with high driving power and high dependency. These variables are non-static, since any change in them affects the entire system, and finally, system feedback can also re-modify these variables. The variables of communication and information technology, the globalization of science and technology, and human resources are in this category. The fourth category consists of independent variables with strong driving power, but weak dependence. This category acts as a structural cornerstone of the system and should be emphasized first and foremost for a fundamental change in the performance of the system. Global economic trends and innovation policies are in this section.

Table 9. Classification of Variables

Independent variables	Dependent variables	Connected variables	Autonomous variables
global economic trends **innovation policies**	R&D and investment in knowledge Business and productivity Innovation performance	ICT Globalization of knowledge and technology Human resources	-

Conclusion

As previously stated, research alone has not led to development, but development is provided through the production of industrial products, the improvement of methods and the provision of services to units and sectors of society and industry. Today, the difference between developed and developing countries is due to innovative thinking and its impact on development and economic growth (Roos, 2016). For this purpose, the present study sought to level innovation indicators. According to the library studies, both in the domain of the subject matter and in the area of the method and technique used in the present research, the innovation of this research in the aforementioned field can be claimed. In the thematic area, according to studies carried out, it can be claimed that the subject has not been addressed in the form of a comprehensive review of production and innovation in product production in any research. No research has also been found to measure the level of innovation indicators and their impact on manufacturing industries. In domestic researches, only a few general indicators have been considered. It should be noted that the dimensions examined in relation to product innovation in the present study, derived from OECD and other models, were essentially of the requisite comprehensiveness in the field of definitions and can be generalized to any other functional subject. With this interpretation, it can be said that the investigations carried out in this study provide an appropriate framework for the leveling of innovation indices in the food industry. According to the findings of the research, the results of leveling the variables of the research using the Interpretative Structural Modeling (ISM) test showed that at the highest level, the components of the performance of innovation, business and productivity, R & D and investment in Knowledge are placed that are greatly affected. The components of business and information technology, science and technology globalization, and human resources are in the second level. At the lowest level, it is the components of global economic flows and innovation policies that are most effective. The classification of variables is also presented in the following table:

Table 10. Classification of Variables

Independent variables	Dependent variables	Connected variables	Autonomous variables
global economic trends **innovation policies**	R&D and investment in knowledge Business and productivity Innovation performance	ICT Globalization of knowledge and technology Human resources	-

In general, according to the research, it can be stated that the results of this research are in line with the results of researches by Roos (2016), Bi et al. (2016), Beynon et al. (2016), Yamamoto and Bellgram (2013), and Vega-Jurado et al. (2008). It is also consistent with the research by Jafari et al. (2014). They state that organizational innovation has a significant impact on product innovation, market performance and innovative company performance. It is also consistent with Hajipour et al. (2013), who argue that market orientation factors that include creation and dissemination of information, customer orientation, and rivalry can affect product innovation, which is consistent with the results of this research. On the other hand, it is consistent with Tomlinson's research (2010). In his research, he integrated the technological innovation with process and product innovation, and showed that there is a positive and significant correlation between the cooperation within the companies and the innovative performance, which is consistent with the results of this research. But in the present study, the DEMATEL, ISM, and Fuzzy Delphi techniques were used to examine and explain the relationships between variables, their leveling and their choice, which is different from other studies in this regard.

In general, based on the results of the research, it appears that Jamm and Roze Talayi food industries groups need information derived from measuring innovation to understand the current status, future developments, gain feedback from positive and negative effects of current policies, and formulate appropriate policies. Also, considering the importance of commercialization of research in the formation of innovation and the fundamental role of companies in this area, it is suggested to use innovation indices at the level of other industries as supplements in addition to leveling innovation indices using the indicators of the present research. Also, in order to know about the position of the manufacturing industry in comparison with other industries, it is recommended to use the indicators provided in this research to measure the level of innovation in other areas and compare with the innovation level of Jamm and Roze Talayi food products groups. To this end, in addition to leveling innovation indices using the indicators of the present research, other innovation indices at the level of other firms should also be used as complementary indices. It is also suggested that the organization should plan to improve the indicators of focusing on the process, focusing on the strategy and focusing on the product, so that the product that it delivers is of at least a new and distinctive feature compared to other products and goods in the market and includes the development of industrial processes implemented in the design, production and distribution of products and services. In addition, it is suggested to plan for the improvement of innovation after considering the technological needs and taking into account the strategic goals of innovation in the organization, which can include R & D activities, attention to knowledge management, the use of new technologies, and keeping pace with new innovations. Also, the results of DEMATEL technique on the main factors of research (structural, behavioral, environmental factors and production processes) (which is not mentioned) showed that the structural variables were of the highest priority, the production process was of the second priority, the environmental factors were of the third priority, and the behavioral factors were of the fourth priority. Also, structural factors had a causal effect on all other variables in the research. And the variable of the production process was the variable that is greatly influenced by other variables.

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