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Presenting a risk management model for creating flexible organizations in companies active in the information technology

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ABSTRACT:
The current research identifies and ranks the effective indicators in risk management to create flexible organizations in companies active in information technology through the ANP technique. It is a descriptive survey. Its statistical population includes managers of information technology companies as well-known experts; they are 30 people selected by a targeted sampling method. Data collection tools were three questionnaires: Delphi, Dimtel, and paired comparison questionnaire. We identified the criteria and sub-criteria in risk management to create flexible organizations in companies active in information technology; they comprise 5 general criteria and 17 sub-criteria: Product/service risk (low-quality products, non-compliance with customer needs, lack of technological creativity, lack of raw materials), organizational risk (activity of risk managers, strategies and techniques, process risks, risks of human resources), technological risk (rapid technological changes, industry competition, lack of access to new technologies), environmental risk (political risks, legal and regulatory risks, economic environment risks), financial risk (increase in inflation, increase in exchange rate, liquidity and cash flow). Finally, we prioritize the indicators with the network analysis technique according to their influence on risk management to create flexible organizations in companies active in information technology: environmental risk, technological risk, organizational risk, product/service risk, and financial risk.

Keywords: risk management, organizational flexibility, information technology

INTRODUCTION:

Countries, especially developing countries that are exposed currently to countless threats, need to find suitable working procedures to better use their God-given resources and solve their economic problems. One of the important strategies is risk management (Simali, 2004).

Risk management is a systematic application of management policies, procedures, and processes of risk analysis, evaluation, and control activities. It is a process of documenting the final decisions and identifying and applying the criteria that bring the risk to an acceptable level. It is a central part of the strategic management of any organization. This method includes processes through which organizations can systematically identify the risks of their activities. A successful risk management approach must be proportional to the level of risk in the organization and aligned with its other activities. Other characteristics of successful risk management include the comprehensiveness of the scope of work, the connection with daily activities, and the dynamism in responding to circumstances (Dodd, 1998).

Traditional risk management focuses on legal and physical risks (such as natural disasters or fires, accidents, deaths, and lawsuits). Financial risk management manages the risks that can govern the use of financial and commercial instruments. Intangible risk management focuses on risks of human capital, such as knowledge risk, relationship risk, and operational process risk. All large companies have risk management teams and small companies and groups informally use risk management (Hewitt and Liebenberg, 2011).

Optimal risk management considers a prioritization process and deals with risks with the highest losses and the highest probability of occurrence and risks with a lower probability of occurrence and lower losses. This process may be practically very difficult. Often balancing between high-risk and low-loss risks and low-risk and high-loss risks may not be handled properly. Since the world of business and industry is facing many developments and transformations such as globalization, outsourcing, and creating strategic alliances, risk management has become increasingly important in the activities of commercial and non-profit organizations.

The issue of risk management has once again received recently the attention of many researchers with the expansion of global markets and competition on the one hand, and sanctions and international pressures on the other hand. Providing a model for risk management in a high-risk environment can help the dynamism and survival of start-up businesses. Obviously, this is necessary in high-risk environments, which can help managers in risk management of companies with new

solutions. Creating flexible and dynamic organizations with a relatively acceptable level of agility in high-risk situations where companies are always facing internal and external risks can reduce the level of risk in those companies to an acceptable level. This research attempted to provide a risk management model to create flexible organizations in companies active in information technology and to help the managers of institutions and domestic companies in risk management. Thus, the current research seeks to answer the following questions: What factors are effective in risk management and the creation of flexible organizations in companies active in information technology? What is the appropriate model for risk management to create flexible organizations in companies active in information technology? Is the presented model valid in the upcoming research?

Theoretical foundations of research

Risk management

Project risk management is one of the major subjects of project management; it includes planning, organization, monitoring, control of all aspects of a project, risk identification, measurement, risk response development, and risk response control (Simoni, 2016). Indeed, risk management is a process that controls and manages the conditions (probability) of unexpected damages. It involves continuous and occasional planning that asks “what if?" Identifying and analyzing risk factors comprises examining the company's operations and asking the repeated question ”What can cause a loss?" and “If damage occurs, how severe is it?" (Mirzaei, 2013).

Flexible organizations

Organizations play a central role in the dynamics of social, economic, and ecological systems. Disasters, incidents, and crises are complex and controversial issues for organizations. Organizational flexibility is an effective goal that continuously helps the organization's performance during business, disasters, and crises. In other words, flexibility enables organizations to manage complex challenges in the organization. Organizational resilience refers to the ability to recover from a shock and return to a normal state. Organizational flexibility refers to the capacity of an organization to reduce the negative effects of a crisis and continue to function normally after the event (Mahmoudi et al., 2017). Table (1) shows the theoretical framework of the research.

Table 1: Theoretical framework

Component	Researcher (year)	Index	Researcher (year)
Product/service risk	Shafia et al. (2013)	Low-quality products	Shafia et al. (2013)
		Non-compliance with customer needs	Shafia et al. (2013)
		Lack of technological creativity	Shafia et al. (2013)
		Lack of raw materials	Shafia et al. (2013)
Organizational risk	Mohammadi and Shojaei (2015); Pagach and War (2008)	The activity of risk managers	Mathews (2013)
		Strategies and techniques	Qaderi et al. (2018); Lavastre et al. (2013)
		Process risks	Qolipour et al. (2017)
Technological risk	Shafia et al. (2013)	Rapid technological changes	Shafia et al. (2013)
		Lack of access to new technologies	Shafia et al. (2013)
		Competition in the industry	Tari Verdi and Jelodar (2012); Gordon Lavastre et al. (2009)
Environmental risk	Gordon Lavastre et al. (2009); Shafia et al. (2013)	Political risks	Qolipour et al. (2016)
		Economic risks	Qolipour et al. (2016); Shafia et al. (2013)

The model was presented logically by examining the background of the theoretical framework of the problem (Figure 1).

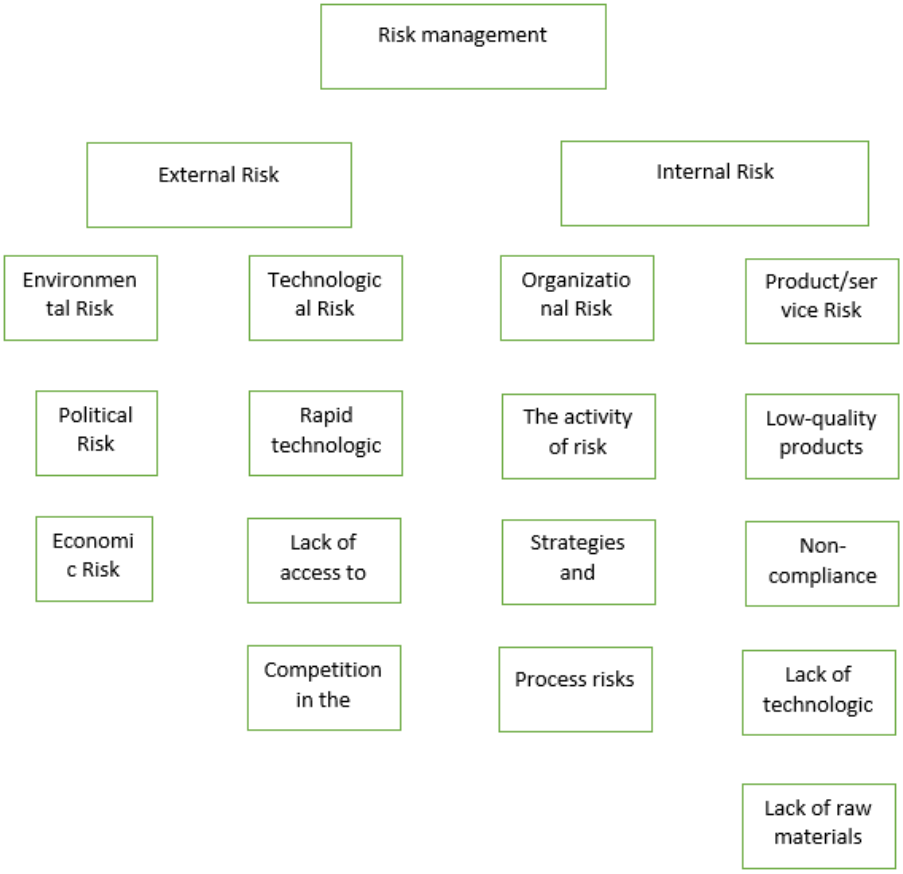

Figure 1: Conceptual model

Research method:

The current research is a descriptive survey with a mixed exploratory approach in its practical purpose. Its statistical population is the managers of the information technology companies as experts who are familiar with risk management in these companies. Their common feature is at least 2 years of management experience, familiarity with risk management concepts, and expertise in IT. The sample size is 30 IT company managers who have been selected as experts by purposive sampling method. The tools and methods of collecting this research fall into two parts: the library method and the survey method. A closed-answer questionnaire tool was used to collect information.

Various sources in risk management are examined in the first stage and the primary indicators of influence on the risk management model are extracted to create flexible organizations in information technology. The final indicators of the risk management model to create flexible organizations in information technology are sifted and identified in the second stage with the help of the Delphi method and asking for opinions from the experts. Finally, the final priority of the elements, criteria, and sub-criteria are determined as the network analysis process model with the help of the network analysis method.

Content validity determined the validity of the questionnaire. Since the indicators were reviewed and finalized by experts in the Delphi stage in two rounds, the questionnaire has a high and confirmed validity. Likewise, formal validity was used to investigate the form and phrasing of the questions of the questionnaires. Thus, the prepared questionnaire was provided to 10 relevant experts, and the necessary amendments were made regarding the phrasing of the questions. The questionnaires were distributed among the research sample. The inconsistency rate is 0.000 in our research. Since it is over 0.01 and is in the target range, the prepared questionnaire has reliability.

The analytic network process (ANP) has been used for checking the criteria. Excel and Super Decision software have been used in the analysis of the research data.

Findings:

First, the researcher extracted a list of criteria affecting risk to create flexible organizations in companies active in information technology. The supervisor removed some criteria and added some others. Finally, we obtained 4 main criteria and 13 sub-criteria, which were transferred to the experts for evaluation in a table through a questionnaire. The final results of the coding process led to the design of Table (2).

Table 2: Main dimensions, components, and variables affecting risk management to create flexible organizations

Row	Main factor	Sub-factor
1	Product/service risk	Low-quality products
2		Non-compliance with customer needs
3		Lack of technological creativity
4		Lack of raw materials
5	Organizational risk	The activity of risk managers
6		Strategies and techniques
7		Process risks
8	Technological risk	Rapid technological changes
9		Lack of access to new technologies
10		Competition in the industry
11	Environmental risk	Political risks
12		Economic environment risks

As we received the answers of the experts in the steps of the Delphi technique and examined the views of the experts, we merged similar or close proposals into one another. The acceptable limit for the criterion is around 70% of the upper limit of the average according to the 30-70 rule. If the average value of experts' opinion is close to 0.7 or higher, it is accepted as an acceptable criterion. Therefore, Table (3) presents the final risk criteria for creating flexible organizations in companies active in information technology according to the opinion of experts.

Table 3: Final factors identified by the Delphi technique

Row	Main factor	Symbol	Sub-factor	Symbol	Obtained average percentage	Status
1	Product/service risk	C1	Low-quality products	C11	100	Confirmed
2			Non-compliance with customer needs	C12	80	Confirmed
3			Lack of technological creativity	C13	80	Confirmed
4			Lack of raw materials	C14	90	Confirmed
5	Organizational risk	C2	The activity of risk managers	C21	100	Confirmed
6			Strategies and techniques	C22	100	Confirmed
7			Process risks	C23	100	Confirmed
8			Risks of human resources	C24	100	Confirmed
9	Technological risk	C3	Rapid technological changes	C31	100	Confirmed
10			Lack of access to new technologies	C32	90	Confirmed
11			Competition in the industry	C33	100	Confirmed

12	Environmental risk	C4	Political risks	C41	100	Confirmed
13			Legal and regulatory risks	C42	80	Confirmed
14			Economic environment risks	C43	100	Confirmed
15	Financial risk	C5	Increase in inflation	C51	100	Confirmed
16			Increase in the exchange rate	C52	80	Confirmed
17			Liquidity and cash flow	C53	80	Confirmed

Table 4: Matrix of the importance, influence, and effectiveness of the criteria

Criterion	J	R	j-R	J+R
Product/service risk (C1)	1.5	2.27	-0.77	3.77
Organizational risk (C2)	1.76	1.44	0.32	3.19
Technological risk (C3)	1.57	1.42	0.15	3
Environmental risk (C4)	1.55	1.93	-0.38	3.48
Financial risk (C5)	2.6	0	2.6	2.6

Column J in Table (4) shows the influence of criteria on other criteria of the model. Therefore, financial risk has the most influence on other criteria.

The R column shows the influence of the criteria on other criteria of the model. Thus, the product/service risk has the most influence over other criteria. The horizontal vector (J+R) is the degree of influence of the desired factor in the system. In other words, the higher the J+R value of a factor, the more interaction that factor has with other system factors. As the results of product/service risk show, they have the most interactions with other studied criteria. The vertical vector (J-R) shows the influence power of each factor. If J-R is positive, the variable is supposed as a causal variable, and if it is negative, it is considered an effect. So organizational risk, financial risk, and technological risk are effects, and product/service risk and environmental risk are causes.

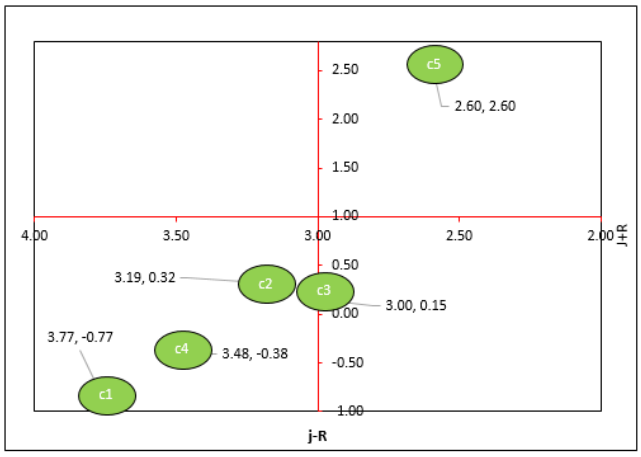

Figure 2: Cause and effect diagram of the main criteria

Likewise, the intensity of the threshold should be calculated to determine the map of network relationships. We can ignore partial relationships with this method and draw a network of significant relationships. This study obtained a threshold of 0.46. Therefore, Table (5) shows the internal dependence of the main criteria on each other, which is determined based on the opinion of experts. One-way connections are marked with (*), two-way connections with (**), and no connections with (-).

Table 5: Internal dependence of the main criteria on each other

Criterion	C1	C2	C3	C4	C5
Product/service risk (C1)	0	0	0	*	0
Organizational risk (C2)	*	0	0	*	0
Technological risk (C3)	0	0	0	*	0
Environmental risk (C4)	0	0	0	0	0
Financial risk (C5)	*	*	*	*	0

We can draw the causal diagram based on the figure below according to the relationship between criteria (Figure 3).

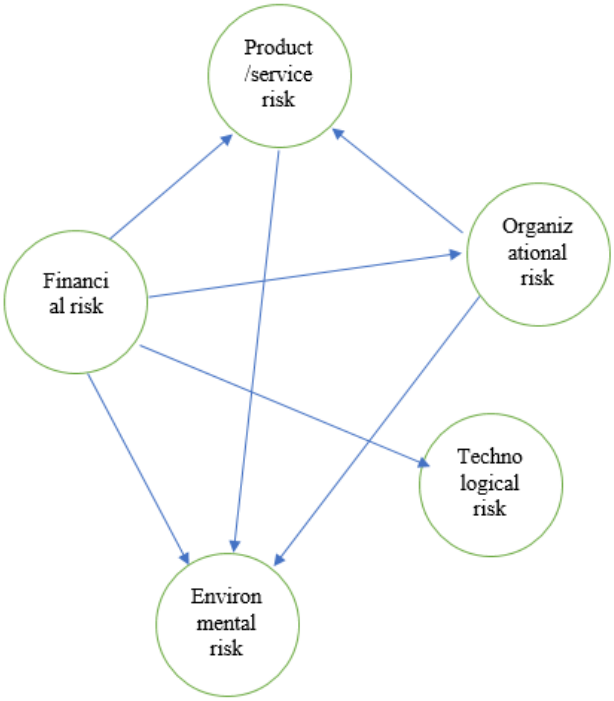

Figure 3: Relationship diagram of the main criteria

We perform Dimetal calculations for the main criteria to determine the internal and external connections between the sub-criteria and the impact of all these calculations for the sub-criteria as well. (Figure 4)

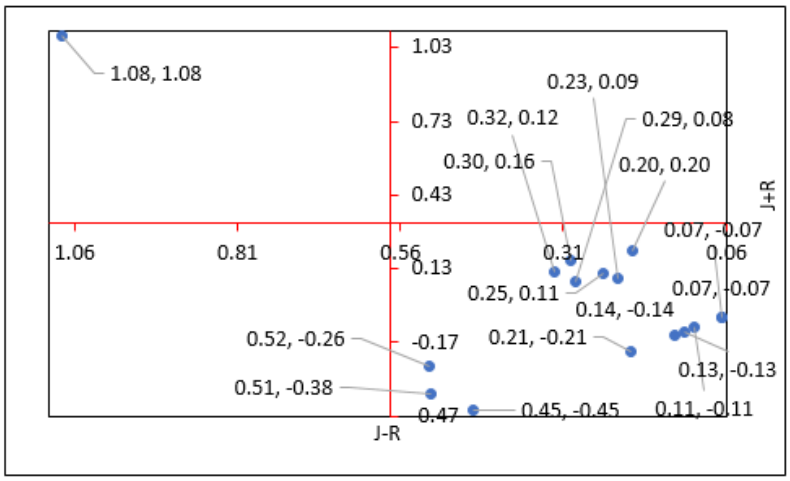

Figure 4: Cause and effect diagram of sub-criteria

The threshold intensity must be calculated to determine the map of network relationships. We can ignore partial relationships with this method and draw a network of significant relationships. Only the relationships whose values in the T matrix are greater than the threshold value will be displayed in the relationship map. It is enough to calculate the average values of the matrix T to calculate the threshold value of relationships. As we determined the intensity of the threshold, we zeroed all the values of the matrix T that are smaller than the threshold. This means that we did not consider the causal relationship. The threshold has been 0.006 in this study. Therefore, Table (6) shows the internal dependence of the main criteria on each other, which is determined based on the opinion of experts. One-way connections are marked with (*), two-way connections with (**), and no connections with (-).

Table 6: Internal dependence of sub-criteria on each other

Criterion	C11	C12	C13	C14	C21	C22	C23	C24	C31	C32	C33	C41	C42	C43	C51	C52	C53
Low-quality products (C11)	0	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-compliance with customer needs (C12)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lack of technological creativity (C13)	*	0	0	0	0	0	0	0	0	0	*	0	0	0	0	0	0
Lack of raw materials (C14)	*	*	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Activity of risk managers (C21)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Strategies and techniques (C22)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Process risks (C23)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Risks of human resources (C24)	*	*	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rapid technological changes (C31)	0	0	0	0	0	*	*	0	0	0	*	0	*	0	0	0	0
Lack of access to new technologies (C32)	*	*	*	*	0	0	0	0	0	0	0	0	0	0	0	0	0
Competition in the industry (C33)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Political	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

risks (C41)																	
Legal and regulatory risks (C42)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Economic environment risks (C43)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Increase in inflation (C51)	*	*	*	0	0	0	0	0	0	0	*	0	0	0	0	0	0
Increase in exchange rate (C52)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0	0
Liquidity and cash flow (C53)	*	*	*	*	0	0	0	0	0	*	*	0	0	0	0	0	0

Analytic Network Technique (ANP*:*

The analytic network technique (ANP) has been used to determine the final weight and prioritize factors affecting risk to create flexible organizations in companies active in information technology. Thus, we selected 5 main criteria and 17 sub-criteria to rank the factors affecting risk to create flexible organizations in the company active in the information technology in the next stage of identifying the most effective criteria to prepare a questionnaire for elites to prioritize, according to the results of the Delphi section. So a paired comparison questionnaire was prepared to survey the elites. The research network model is drawn in Figure (5) according to the criteria, sub-criteria, and their internal relationships.

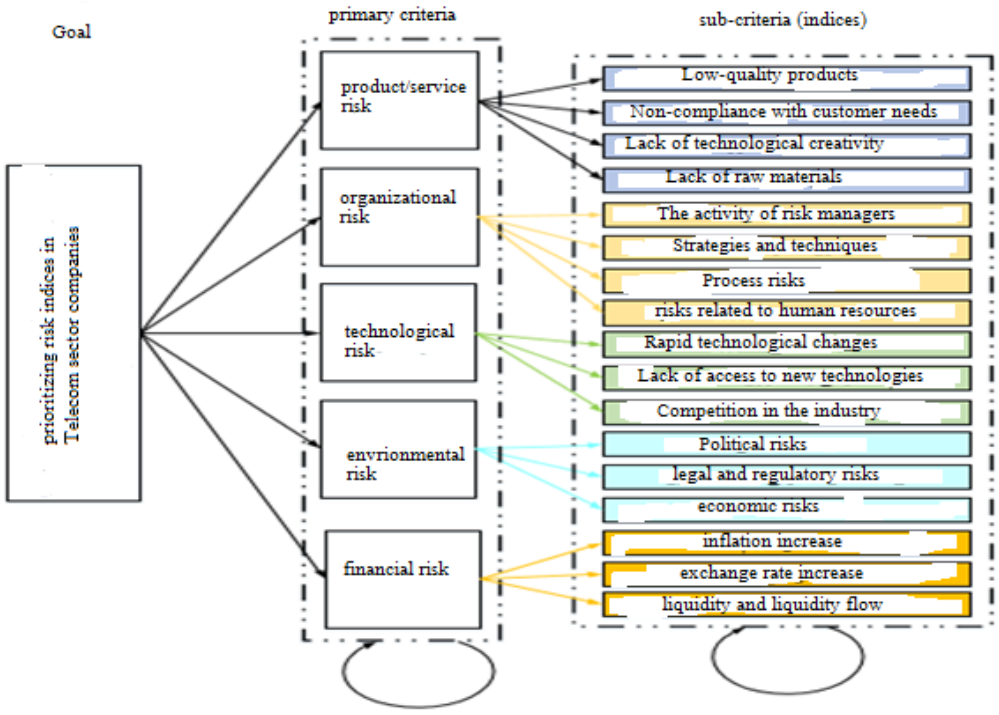

Figure 5: Network of indicators that affect risk management in creating flexible organizations

Sub-criterion: Low-quality products, Non-compliance with customer needs, Lack of technological creativity, Lack of raw materials, Activity of risk managers, Strategies and techniques, Process risks, Risks of human resources, Rapid technological changes, Lack of access to new technologies, Competition in the industry, Political risks, Legal and regulatory risks, Economic environment risks, Increase in inflation, Increase in the exchange rate, Liquidity and cash flow
Main indicators: Product/service risk, Organizational risk, Technological risk, Environmental risk, Financial risk Prioritization of risk indicators in Telecom sector companies

We formed, in the following, all pairwise comparison matrices including the pairwise comparison matrix of the criteria concerning the target and the pairwise comparison matrices of the options concerning each criterion. The relative weights and inconsistency rate are calculated for each of these matrices (Table 7).

Table 7: Pairwise comparison matrix of the 5 main indicators that affect risk management in creating flexible organizations

5 indicators	Product/service risk	Organizational risk	Technological risk	Environmental risk	Financial risk	Weight
Product/service risk	1	4	0.153	0.156	4	0.14397
Organizational risk	0.25	1	4.14	1	1.12	0.17976
Technological risk	6.55	0.241	1	1	6	0.27362
Environmental risk	6.43	1	1	1	4	0.33414
Financial risk	0.25	0.893	0.167	0.25	1	0.06851
Inconsistency rate 0.0034						

The results of Table (7) show that the five main risk indicators to create flexible organizations in companies active in information technology are technological risk, environmental risk, organizational risk, product/service risk, and financial risk. We also examined and determined the sub-criteria of each one after determining the importance of each of the main criteria. The calculations of the sub-factors are also solved in a similar way.

A binary comparison between the main criteria is done to obtain the elements of the W22 matrix and understand the interdependence between the main criteria.

Table 8: Binary comparison of the main criteria according to their internal dependence on financial risk control

Financial risk	Environmental risk	Technological risk	Organizational risk	Product/service risk	Weight
Product/service risk	5	0.125	6	1	0.30915
Organizational risk	6	1	1	0.167	0.22227
Technological risk	1	1	1	8	0.37362
Environmental risk	1	1	0.167	0.2	0.09497
Inconsistency rate 0.0522					

As Table (8) shows, the binary comparison of the internal dependence of the main criteria according to weight are technological risk, product/service risk, organizational risk, and environmental risk.

Since we have calculated all the comparative matrices in the structure of the unbalanced matrix and controlled their compatibility, we could obtain a balanced and limit supermatrix.

The last step, after calculating the limit supermatrix, to determine the final value and coefficient of the elements is to calculate the results of the cluster matrix and normalize the coefficient of the sub-criteria in the limit supermatrix by the clustering coefficient based on the calculations. Tables (9) and (10) specify limit supermatrix and final priority of the main criteria and sub-criteria that affect risk indicators in creating flexible organizations in companies active in information technology.

Table 9: Final weight of the main criteria that affect risk management to create flexible organizations

Criterion	Symbol	Weight	Ranking
Product/service risk	C1	0.09734	4
Organizational risk	C2	0.11290	3
Technological risk	C3	0.17307	2
Environmental risk	C4	0.58221	1
Financial risk	C5	0.03448	5

As Table (9) shows, environmental risk with a threshold weight of 0.58221 has the greatest impact, and financial risk with a threshold weight of 0.03448 has the least impact on risk to create flexible organizations in companies active in information technology.

Table 10: Final weight of sub-criteria that affect risk management in creating flexible organizations

Sub-criterion	Symbol	Final weight	Ranking
Low-quality products	C11	0.04980	3
Non-compliance with customer needs	C12	0.161156	2
Lack of technological creativity	C13	0.028591	7
Lack of raw materials	C14	0.01667	8
The activity of risk managers	C21	0.00249	16
Strategies and techniques	C22	0.00799	11

Process risks	C23	0.016829	9
Risks of human resources	C24	0.00268	15
Rapid technological changes	C31	0.00334	14
Lack of access to new technologies	C32	0.03048	6
Competition in the industry	C33	0.04290	5
Political risks	C41	0.01544	10
Legal and regulatory risks	C42	0.20717	1
Economic environment risks	C43	0.04560	4
Increase in inflation	C51	0.00398	13
Increase in the exchange rate	C52	0.00553	12
Liquidity and cash flow	C53	0.00051	17

As Table (10) shows, the legal and regulatory risks sub-criterion with a threshold weight of 0.20717 has the greatest impact and the liquidity and cash flow sub-criterion with a threshold weight of 0.0051 has the least impact on risk in creating flexible organizations in companies active in the information technology. Table (11) gives other ranks.

Table 11: Final weight of cluster criteria that affect risk management to create flexible organizations

Sub-criterion	Symbol	Cluster	Normalized weight for each cluster	Ranking
Low-quality products	C11	Product/service risk	0.19407	2
Non-compliance with customer needs	C12		0.62956	1
Lack of technological creativity	C13		0.11141	3
Lack of raw materials	C14		0.06496	4
The activity of risk managers	C21	Organizational risk	0.08323	4
Strategies and techniques	C22		0.26653	2
Process risks	C23		0.56074	1
Risks of human resources	C24		0.08950	3
Rapid technological changes	C31	Technological risk	0.04347	3
Lack of access to new technologies	C32		0.39727	2
Competition in the industry	C33		0.55926	1
Political risks	C41	Environmental risk	0.05756	3
Legal and regulatory risks	C42		0.77242	1
Economic environment risks	C43		0.17003	2
Increase in inflation	C51	Financial risk	0.39701	2
Increase in the exchange rate	C52		0.55192	1
Liquidity and cash flow	C53		0.05107	3

As Table (11) shows, the final weight of sub-criteria that affect risk management in creating flexible organizations in companies active in the information technology for each of the clusters are:

Cluster (main criteria) of product/service risk: non-compliance with customer needs, low quality of products, lack of technological creativity, and lack of raw materials.

Cluster (main criteria) of organizational risk: process risks, strategies and techniques, risks of human resources, and activity of risk managers.

Cluster (main criterion) of technological risk: competition in the industry, lack of access to new technologies, and rapid technological changes.

Cluster (main criteria) of environmental risk: legal and regulatory risks, economic environment risks, and political risks.

Cluster (main criteria) of financial risk: increase in exchange rate, increase in inflation, and liquidity and cash flow.

Conclusion

The current research presents a risk management model to create flexible organizations in companies active in information technology. The data identification section described the content, theoretical foundations, and Delphi analysis and identified the effective risk criteria and sub-criteria for creating flexible organizations in companies active in information technology (5 general criteria and 17 sub-criteria).

The research determined the relationships between the criteria and sub-criteria and specified them in a one-way and two-way manner through the Dimatel technique and by obtaining the opinion of experts. Product/service risk is related to environmental risk. Organizational risk has a relation with product/service risk and environmental risk. Technological risk is associated with environmental risk. Financial risk has a relationship with product/service risk, organizational

risk, technological risk, and environmental risk. We also identified the relationship between research sub-criteria. The low quality of products is associated with non-compliance with customer needs. Lack of technological creativity is associated with low-quality products and competition in the industry. Lack of raw materials has a relationship with low-quality products, lack of compliance with customer needs, and lack of technological creativity. Risks of quality human resources are associated with low products, non-compliance with customer needs, and lack of technological creativity. Rapid changes in innovation have a relationship with strategies and techniques, process risks, competition in the industry, and risks of the brand. Lack of access to new technologies is associated with low-quality products, lack of compliance with customer needs, lack of technological creativity, and lack of raw materials. An increase in inflation has a relationship with low quality of products, lack of compliance with customer needs, lack of technological creativity, and lack of competition in the industry. An increase in the exchange rate is associated with low quality of products, lack of compliance with Customer needs, lack of technological creativity, lack of raw materials, activities of risk managers, strategies and techniques, process risks, risks of human resources, rapid changes in technology, lack of access to new technologies, competition in the industry, political risks, legal and regulatory risks, risks of the economic environment, and the increase in inflation. Liquidity and liquidity flow have a relationship with the low quality of products, non-compliance with customer needs, lack of technological creativity, lack of raw materials, lack of access to new technologies, and competition in the industry.

A network analysis technique was used to measure the weight, importance, and priority of the designed indicators. The main criteria for risk management to create flexible organizations in companies active in information technology are environmental risk (0.58221), technological risk (0.17307), organizational risk (0.11290), product/service risk (0.09734), and financial risk (0.03448). Finally, comparing all the sub-criteria with each other provided the weight and priority of the final sub-criteria. It shows that the highest weight and importance is about the index of legal and regulatory risks (0.20717) and the lowest weight and importance in risk management is for the index of liquidity and cash flow (0.00051).

These results are consistent with those of Fan (2004) (Risk Management and Managerial Efficiency in Chinese Banks), Gordon (2009) (examining the effect of over-forecasting profit on risk and value management), Al-Shatti (2014) (investigating the effect of risk management and liquidity management on the performance of commercial banks in Jordan during the years 2005 to 2012), and Simoni (2016) (investigating the relationship between risk management and average stock returns in companies with financial crisis).

A detailed analysis of the organizational environment and the external environment of the organization can control the environmental risk. The creation of a market research unit can identify legal risks, political risks, and risks of the turbulent economic environment of the country by making changes in human resources, redesigning the organization, and managerial changes. The structure of confidentiality of information in the company because of their valuable data and administrative bureaucracies to obtain the necessary permits to distribute the questionnaire were also the other limitations of the research.

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