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Formulation and explanation of a success model in innovation management and its diffusion at sports federations

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C H R O N I C L E

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A B S T R A C T

Since today's world is moving ahead rapidly, the condition for the survival and durability of institutions and organizations depend on research, development, innovation, and communication, the realization of which requires the presence of a new and creative model. Therefore, this paper aims to formulate and explain an open successful innovation management model by seeking the factors affecting the diffusion of innovation model at sports federations. The study in term of goal is applied and in term of data analysis method is descriptive correlational study. The statistical population consists of sports federations of Iran in 2017. The sample size was 70 individuals selected using Morgan table and the simple random sampling method from 10 federations. The research collection data tool was a questionnaire. The correlation matrix was used to determine the relationships between independent and dependent variables. Furthermore, a novel hybrid technique of fuzzy DEMATEL and fuzzy ANP was used to rank the factors affecting open innovation. The results showed that structural factors, interorganizational joint venture, customer relationships, research and development department, and new technologies affected the open innovation. Moreover, structural factors were ranked the most effective factors. Then, customer relationships and interorganizational joint venture were known as the weakest factors affecting the creation of open innovation.

1. Introduction

Innovation in word defined as operationalized creativity. Accordingly, Peter Drucker believed that what was common among entrepreneurs was not a specific type of character but a systematic commitment to innovation (Seventeen Bodies, 2011). Conventional innovation models needed to rely on intra-organizational intellectual resources, prevention of information, and the use of external forces. Every invention, business secret, and other valuable intellectual properties were protected strongly. The relevant laws were enforced without any mercy so that innovative organizations could obtain the highest value from their innovations (Chesbrough et al., 2014; Chang, 1992). Open innovation leads to more interactions among the activists of this area such as agencies, their supplier networks, market, and customers. Since open innovation has been used particularly in the industry and market, many of the other

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organizational structures can easily implement and execute the principles of open innovation. Open innovation is equally related to service and manufacturing companies. The studies of open innovation should not be limited to small and medium companies involved in research and development activities. However, it should be implemented at different companies and organizations. The market-related goals are usually the main motive for open innovation. Such goals provide the main impetus for companies to risk their capitals, cooperate with other companies, and collaborate with customers in the innovation process (Saeedi & Statoil, 2011).

The majority of small and medium companies benefit from a wide variety of methods to satisfy customer needs and survival in the competitive market. Corporate restructuring and the reengineering of organizational business can serve as the second important motive for open innovation (Hashemi Dehghi, 2014). Active companies can benefits from open innovation including reduction in research and development expenditures, potential for improvement in the productivity of development, customer participation in the development process, increased accuracy of market research and target customers, synergy of internal and external innovation, and potential for network marketing (Parhizgar et al., 2014). The implementation of an open innovation model is naturally faced with a numerous risks and challenges, some of which including: the probability of disclosing the information which is not supposed to be shared; the potential to lose the competitive advantage of organizations as a result of disclosing their intellectual property; increase complications in the control of innovation and regulations and how participants are involved in a project; and the need for the formulation of a tool which can be used to identify the accuracy and combination of external innovation (Parhizgar et al., 2014).

Regarding the support provided by the government and according to the new infrastructures, many knowledge-based companies have emerged in various areas of technology and research services in Iran. They have provided the groundwork for following the open innovation paradigm by improving the scientific level of universities, increasing the quantity and quality of majors and graduates, promoting entrepreneurship culture, etc. For this reason, the inadequacy of the in-house research capability and benefiting from national technological capability, as well as providing technological developments for other sectors are considered to be in the framework of open innovation theory versus closed innovation (Tabatabeeian, 2011).

Open innovation is defined as the purposeful utilize of the insourcing and outsourcing stream of technical knowledge to accelerate the internal processes of innovation and expand the market for the external use of innovations. Obviously, the main problem is that when the innovation activity is shared among a large number of activists, the hierarchical collaboration model is not sufficient and other collaboration mechanisms are required. When external knowledge and relevant activists form a large part of the process, the innovation process of a company requires adaptation to changes in the criteria for the innovation activity (Khamseh & Radfar, 2012; Kahraman et al., 2004).

2. Research Background

Schwab et al. (2011) presented a comprehensive innovation model for service innovations, particularly. The comprehensive innovation management model integrates the market-based view with the resource-based view by merging the enterprise environment into internal capabilities and resources. This model is focused on the innovation process and four effective areas including: customers, rivals, employees, and system. The model is based on the assumption that customer-orientation reduces the market uncertainty, and the main challenge is to predict future needs of customers and convert them into presentable products and services. For this purpose, customer interaction and integration into the innovation process are inevitable. Gassmann and Enkel (2005) identified the factors affecting the implementation and dissemination of open innovation models. Accordingly, innovation management can vary in different aspects of external factors such as the economic sector, knowledge, type of innovation, historical periods,

and relevant countries. The intensity of knowledge used to develop a product determines the necessity of merging externally additional knowledge.

Barjooee et al. (2015) addressed the direct and interactive effects of these two dimensions and business innovation on the performances of companies. Using the structural equation modelling technique, they tested their research hypotheses. They showed that open innovation had a positive and significant effect on business innovation, a fact which affected the performances of knowledge-based companies in the Science and Technology Park of Bushehr, Iran.

Khosro Pour and Mirafshar (2014) carried out a study on analyzing a system using open innovation in an oil industry for a case study in Statoil and Shell Company by analyzing the execution process, implementation model, and key factors to the success of those two companies. Finally, a comparison was drawn to describe how the two companies were different in the implementation of this approach. According to the research results, the two companies used the same implementation method; however, there were certain executive differences in terms of challenges, receiving processes, analysis, development, and implementation.

Hashemi Dehghi (2014) carried out a study on open innovation and the necessity of implementation it at organizations. Since open innovation has been considered as the modern paradigms of innovation, it is used very well in multinational powerful organizations. The tools developed in this paradigm resulted in higher value-added at companies in addition to improve the qualitative level of products and the higher satisfaction of demanding customers. The study is of review type that by defining open innovation and developing a conceptual model and executed techniques in Iran and the world tried to show the necessity of implementing the aforesaid plan at organizations for customer satisfaction and organizational business reengineering. Since the majority of large, medium, and small manufacturing and economic companies lack applied research and development departments to achieve innovation-oriented technologies, the national open innovation plan can establish dynamic and mutual interactions between innovation owners and manufacturing employers. Therefore, the entire hidden national capacities of universities, teachers, students, developers of top ideas, and innovative entrepreneurs can be used to solve the problems of industry and production. As a result, there can be efficient connections among universities, industries, and the state.

Nargesi et al. (2014) identified the factors affecting the implementation of open innovation. For this purpose, they considered the main factors affecting open innovation in two dimensions of internal factors (structure, process, finances, and employees) and external factors (cooperation with rivals, customer relationship, political/legal factors, and academic relationships). The path analysis was used to analyze the resultant data in PLS. The findings of the study showed that all of the identified dimensions of internal and external factors affected the implementation of open innovations.

Lindegaard and Kawasaki (2012) developed a model for the evaluation of national innovation system to introduce a specific classification of national innovation indicators providing the qualitative and statistical analyses of this system. In this model, national innovation indicators were classified as inputs, mediators, and outputs. The most important inputs were workforce and capital. The most important mediators were the accumulation of macro capabilities in science and technology in addition to the size of capital or economic and human wealth. Finally, the outputs included solutions, base knowledge, and productivity.

Wang et al. (2012) in a study determined the effect of open innovation on national systems. The results of study show that the following factors could make significant effects on the organization: using external knowledge, the presence of basic studies, promoting of undeveloped technology markets, strengthening internal relationships, interorganizational joint ventures, the presence of high-quality

workforce, expansion of education, the presence of an interorganizational network, investing in research and development department, and hiring retired employees.

Zhang and Huang (2010) carried out a study on *open innovation model in the business process of Chinese telecommunication operators*. The results of the study show that the following factors could help achieve open innovation in an organization: employing intelligent experts inside the organization, using external and internal research and development departments, creating the belief that research and development are not necessary for innovation at the beginning of a subject, creating a better business model to achieve a market forming for the first time, and using internal and external ideas i.e. benefiting from others in the innovation process or purchasing other people's intellectual properties when they can improve the business.

Darbandi and Khorshidi (2009) conducted a study to analyze the role of open innovation in developing innovation. The results of the study show that the following factors could affect the use of open innovation in an organization: outsourcing, using new technologies and technology transfer (Lee et al., 2012), using external resources and partnership with other organizations to adopt their ideas, and changing organizational culture in contrast with external cooperation. Regarding open innovation, it is not necessary to use the entire necessary workforce or to have the best and most ideas, but also it is important to make the optimal use of internal and external ideas.

3. Research Methodology

In this study, a series of valid and systematic regulations, tools, and strategies were used to investigate realities, discover the unknown, and come up with solutions. The only way of making acceptable and scientific achievements is to use the scientific research method (Khaki, 2009). Generally, there are different research methods such as causal, correlational, causal-comparative, descriptive, historical, and case study. Each method is used in a specific situation. In general, research methods can be classified according to two criteria: research goal and data collection method.

Therefore, this study in terms of the goals is applied and in terms of the degree and the significance of the variables and the amount of control is the field and in terms of the data collection tool is a survey type and in terms of data analysis method is descriptive. It is also a descriptive-correlational work of research.

3.1. Statistical Population and Sample

In every study, the research population is a statistical population in which a researcher is willing to conduct a study regarding the attribute or attributes of its variables. If the statistical population is not very large, it is regarded as the research sample. However, if the statistical population is large, a sample is first introduced and then selected. Finally, the results are generalized to the entire statistical population. In this study, the Morgan sample size determination table and the simple random sampling methods were used to select the samples.

The statistical population included the sports federations of Iran. The Morgan table and the simple random sampling method were used to select 70 individuals from 10 sports federations. Then a questionnaire was distributed among them. The correlation matrix was used to determine the relationships of independent and dependent variables. Finally, a novel hybrid technique of DEMATEL and fuzzy ANP (Saaty, 2004; Azar & Faraji, 2008) was used to rank the factors affecting open innovation.

3.2. Statistical Tests and Techniques

In this study, descriptive statistics were used to analyze the data of questionnaires in SPSS. Furthermore, a researcher-made questionnaire was used in a five-point Likert scale with closed items to collect the quantitative data. Regarding the inferential statistics, the Kolmogorov-Smirnov test was used to check the normality of variables. Since variables were normal, the correlation matrix was used to analyze the relationships of independent and dependent variables. Moreover, a novel hybrid technique of DEMATEL and fuzzy ANP was used to rank variables. Then the data of questionnaires were analyzed in SPSS 21.

4. Data Analysis

4.1. Testing the Reliability of Questionnaire

There are different methods to determine the reliability of a measuring tool. One of them is the evaluation of internal consistency. The internal consistency of a measurement tool can be determined using Cronbach's alpha. Table 1 shows the values of this coefficient for the questionnaire used in this study:

Table 1
Cronbach's Alpha for the Questionnaire Reliability

Variables	Evaluation Method	Cronbach's Alpha
Structural Factors	Five-Point Likert Scale	0.855
Interorganizational Joint Venture	Five-Point Likert Scale	0.841
Customer Relationships	Five-Point Likert Scale	0.815
Research and Development Department	Five-Point Likert Scale	0.897
New Technologies	Five-Point Likert Scale	0.798

According to Table 1, the Cronbach's alpha of each section shows that the questionnaire is acceptably reliable because the values are all above 0.7.

4.2.Testing the Normality of Data

The Kolmogorov-Smirnov test was used to determine data normality. This test is a nonparametric simple method used to determine the consistency of data with the designated statistical test. The output of this test is a table in which the smaller values of Z statistic show whether data distribution is acceptable.

Table 2
The Kolmogorov-Smirnov Test for Data Normality

Variables	Quantity	Z	P-value	Result
Structural Factors	70	0.57	0.021	Normal
Interorganizational Joint Venture	70	0.24	0.031	Normal
Customer Relationships	70	0.72	0.036	Normal
Research and Development Department	70	0.79	0.025	Normal
New Technologies	70	0.11	0.042	Normal

Table 2 show that the significance levels of variables was above 0.05; therefore, the null hypothesis (data normality) was confirmed.

4.3.Correlation of Research Variables

Since data were normal, the correlation matrix was used to determine the relationships and correlation coefficients of independent and dependent variables. The results are as follows:

Table 3
Correlation Matrix of Research Variables

Variables	1	2	3	4	5	6
Structural Factors	1.000					
Interorganizational Joint Venture	0.144	0.554	1.000			
Customer Relationships	0.368	0.544	0.625	1.000		
Research and Development Department	0.382	0.457	0.526	0.533	1.000	
New Technologies	0.416	0.366	0.514	0.491	0.685	1.000

* all correlations are significant at a 0.05 level of significance

According to Table 3, the significance of the correlation matrix was below 0.05 for all of the research variables, so the null hypothesis was rejected. Therefore, research variables were in positive and significant relationships with each other at a 99% level of confidence.

4.4. Using a novel hybrid technique of DEMATEL and fuzzy ANP to Rank the Factors and Variables

In this study, a novel hybrid technique of fuzzy DEMATEL and fuzzy ANP was used to rank the factors affecting open innovation. It should be noted also that descriptive statistics were used to analyze the data of questionnaires in SPSS. For this purpose, procedures and analyzes are described below.

• *First phase: Extraction of factors*

At this phase, reviewing the literature and expert opinion 5 variables "Structural Factors", "Interorganizational Joint Venture", "Customer Relationships", "Research and Development Department" and "New Technologies" as the main factors affecting innovation were extracted. Table 4 shows the factors affecting innovation.

Table 4
Factors Affecting Innovation

Factor	Abbreviation	Factor	Abbreviation
New Technologies	C1	Structural Factors	C4
Research and Development Department	C2	Interorganizational Joint Venture	C5
Customer Relationships	C3		

- *Second phase: Implementation of fuzzy DEMATEL method*

At this phase, the membership function of the linguistic variables is used to collect the views of the team members on the pairwise comparison of criteria, as described in Table 5. According to Table 5, linguistic assessments have been carried out using equivalent triangular fuzzy numbers and using fuzzy method of converting fuzzy data into crisp scores and using relations 1 to 9, are converted to final numbers. As a result, the initial matrix direct relationship with final numbers is formed. Then the initial direct matrix normalized using relation 10, and using the total relation matrix T is calculated using relation 11. Matrix T after normalizing placed as a matrix W22 in the initial super matrix.

Table 5
Linguistic variables and equivalent fuzzy numbers (Zhu et al., 2012)

Linguistic Variable	Certain equivalent	Equivalent Fuzzy Number (a)	Equivalent Fuzzy Number (b)
Very little	0	(0, 0.1,0.3)	(0, 0, 0.25)
Little	1	(0.1, 0.3, 0.5)	(0, 0.25, 0.5)
Average	2	(0.3, 0.5, 0.7)	(0.25, 0.5, 0.75)
Much	3	(0.5, 0.7, 0.9)	(0.5, 0.75, 1)
Too much	4	(0.7, 0.9, 1)	(0.75, 1, 1)

$$xl_{ij}^{k} = \frac{l_{ij}^{k} - min_{1\le k\le K} l_{ij}^{k}}{\Delta_{min}^{max}}, \quad (1)$$

$$xm_{ij}^{k} = \frac{m_{ij}^{k} - min_{1\le k\le K} l_{ij}^{k}}{\Delta_{min}^{max}}, \quad (2)$$

$$xr_{ij}^{k} = \frac{r_{ij}^{k} - min_{1\le k\le K} l_{ij}^{k}}{\Delta_{min}^{max}}, \quad (3)$$

$$\Delta_{min}^{max} = \max r_{ij}^{k} - \min l_{ij}^{k}, \quad (4)$$

$$xls_{ij}^{k} = \frac{xm_{ij}^{k}}{1 + xm_{ij}^{k} - xl_{ij}^{k}}, \quad (5)$$

$$xls_{ij}^{k} = \frac{xr_{ij}^{k}}{1 + xr_{ij}^{k} - xm_{ij}^{k}}, \quad (6)$$

$$x_{ij}^{k} = \frac{xls_{ij}^{k}\left(1 - xls_{ij}^{k} + xrs_{ij}^{k}\right) + xrs_{ij}^{k} xrs_{ij}^{k}}{1 + xrs_{ij}^{k} - xls_{ij}^{k}}, \quad (7)$$

$$BNP_{ij}^{k} = \min l_{ij}^{k} + x_{ij}^{k}\Delta_{min}^{max}, \quad (8)$$

$$a_{ij} = \frac{1}{k}\sum_{k}^{1\le k\le K} + BNP_{ij}^{k}, \quad (9)$$

$$X = s \times A, \quad (10a)$$

$$S = min\left[\frac{1}{max_i \sum_{j=1}^{n} \backslash a_{ij} \backslash}, \frac{1}{max_j \sum_{j=1}^{n} \backslash a_{ij} \backslash}\right]. \quad (10b)$$

To obtain matrix T, the following relation is used:

$$T = X + X^2 + \cdots + X^k = X(i + X + X^2 + \cdots + X^{k-1})(1 - X)(1 - X)^{-1} = X(1 - X^k)(1 - X)^{-1} \quad (11a)$$

where $lim_{k\to\infty} X^k = [0]_{n\times n}$, the total relation matrix T obtained through the following relation.

$$T = X(1 - X)^{-1} \quad (11b)$$

• *Third phase: implementation of fuzzy ANP with fuzzy DEMATEL*

In this phase, pairwise comparison of the main factors is carried out. The data for this phase is collected by a pairwise comparison questionnaire. For example, the combination of expert opinions for pairwise comparison of new technologies variable, can be calculated using Eq. (12), then defuzzification performed using CFCS and using relations 3 to13, the weight of factors is calculated (inconsistency rate is zero at this phase).

$$c_j = \sum_{0\le i\le n} T_{ij} \quad (12)$$

$$r_i = \sum_{0\le j\le n} T_{ij} \quad (13)$$

• *Fourth Phase: identify and rank the main factors affecting open innovation*

To perform the required analysis, the weight of the limit super matrix has been used to rank the factors affecting open innovation. To identify the causal factors, r_i, c_j and r_i-c_j using Eq. (12) and Eq. (13), are calculated and their values are recorded.

As mentioned, after the assessment and monitoring of determined variables, a novel hybrid technique of fuzzy DEMATEL and fuzzy ANP was used to rank the factors affecting open innovation. Now, the results of this technique are presented. As mentioned, the first phase of the network decided that this network was presented in the previous sections. In the next phase, the implementation of DEMATEL technique is described to form the relations matrix. The total relation matrix is obtained using fuzzy DEMATEL method as shown in Table 6.

Table 6
Total relation matrix (fuzzy DEMATEL output)

	New Technologies	Research and Development Department	Customer Relationships	Structural Factors	Interorganizational Joint Venture	r_i
New Technologies	0.0742	0.475	0.565	0.457	0.297	1.411
Research and Development Department	0.842	0.803	0.955	0.845	0.838	3.438
Customer Relationships	0.142	0.384	0.088	0.078	0.082	0.695
Structural Factors	0.172	0.332	0.379	0.451	0.936	1.818
Interorganizational Joint Venture	0.784	0.351	0.451	0.654	0.145	2.02
c_i	1.230	1.993	1.997	2.153	1.984	
r_i-c_i	0.181	1.445	-1.338	-0.335	0.121	
Kind of factors	cause	cause	effect	effect	Cause	

As can be seen in Table 6, in this level of computation, according to the output of fuzzy DEMATEL method, new technologies, research and development department and interorganizational joint venture are "cause" and customer relationships and structural factors are "effect". As mentioned in the previous section, this matrix as a matrix W22 in the initial super matrix of fuzzy ANP method is used. To form the initial super matrix it is needed to form matrixes W32 and W11. As mentioned, matrix W32 obtained from the pairwise comparison of the main factors. To identify causal relation, r_i, c_j, r_i-c_j calculated and the results are shown in Table 7.

Table 7
The model of causal relations

Kind of factors	R_i-c_j	c_j	r_i	Factors
cause	0.0034	0.0066	0.01	New Technologies
cause	0.0186	0.0129	0.0315	Research and Development Department
effect	0.0043-	0.0114	0.007	Customer Relationships
effect	0.0177-	0.0301	0.0125	Structural Factors
cause	0.0125	0.0124	0.02	Interorganizational Joint Venture

As can be seen in Table 7, the results according to the output of fuzzy ANP method, new technologies, research and development department and interorganizational joint venture are "cause" and customer relationships and structural factors are "effect". Therefore, the results of using novel hybrid technique of fuzzy DEMATEL and fuzzy ANP show that the priority of each of the above factors is as Table 8:

Table 8
The final rank of the factors

Factors Affecting the Open Innovation Model	Degree of Importance Obtained from novel hybrid method	Ranks in Degree of Importance
Structural Factors	0.56	1
R&D Department	0.48	2
New Technologies	0.39	3
Customer Relationships	0.31	4
Interorganizational Joint Venture	0.25	5

According to Table 8, the structural factors (0.56) were ranked the first factors affecting innovation, a fact that shows they were considered the most important by experts. After that, research and development department, new technologies, customer relationships, and interorganizational joint venture were ranked the second, third, fourth, and fifth factors, respectively.

5. Conclusion

Since today's world is moving ahead rapidly, the condition for the survival and durability of institutions and organizations depends on improving the knowledge of experts and practitioners, enhancing practical training and collaborating with other organizations. Such important goals can be achieved only through research, development, innovation, and communication, the realization of which requires the presence of a new and creative model. Therefore, this has tried to formulate and explain an open successful innovation management model by seeking the factors affecting the diffusion of innovation model at sports federations. Given the fact that most of manufacturing and economic companies are faced with the lack of research and development departments, the national innovation plan can fill this gap. The open innovation plan has been considered as a fuel for the engine of economy. In other words, if the groundwork is provided for innovation in every organization, employment is increased and at the end, technologies are conveyed. Innovation has become very important in today's ever-changing organizations which intend to stay in competition with their rivals and survive the cycle of changes. To put it another way, innovation is considered as an essential factor in organizations to create sustainable competitive advantage and value in today's complicated and variable environment. In fact, only innovative organizations can maintain integrity and satisfy the needs of customers and stakeholders in time in the current variable and knowledge-based environment.

Open innovation is a paradigm in which a company is supposed to benefit well from external ideas along with the internal and external path towards the market. In this paradigm, the boundaries and environment of a company have become more vulnerable; therefore, innovation can easily flow in and out of the organization. Structural factors, interorganizational joint venture, customer relationships, research and development department, and new technologies are the most important factors affecting innovation development in today's organizations, especially sports federations. Paying attention to these factors provide the necessary groundwork for the growth and development of innovation in organizations. It is essential to design and explain a model including all the factors affecting innovation development at sports federations. The lack of such a model is a theoretical gap. The aim of this study was to analyze dimensions, factors, and components affecting the development of open innovation in order to evaluate the effect and rank of each factors at sports federations. According to the research findings, all of the five groups of factors affected open innovation. Structural factors were ranked the first and most important factors. Then the use of research and development department, the use of new technologies, customer relationships, and interorganizational joint venture were ranked the second, third, fourth, and fifth factors respectively. Therefore, customer relationships and interorganizational joint venture were the weakest variables in the developing open innovation model. Finally, it is suggested that this study be re-conducted in other institutions, organizations, and innovation centers to determine the importance scales of these criteria can be measured at companies stationed in growth centers. The differences in the importance of these factors should also be determined in other innovation centers. Regarding the importance of these factors at every organization, efforts should be made to improve the most important criteria. Therefore, the groundwork can be provided for the development of Iran in other areas with respect to current facilities and capabilities.

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