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Factor Analysis of the Performance Evaluation Indices of Research Centers

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Abstract: Research is the tool for developing and extending the borders of the science and knowledge. As authorities of the research through administering and conducting practical, developmental, and fundamental researches, the research organizations (universities and research centers) extend the borders of the science and knowledge in all fields and offer some integrated solutions for the challenges facing the human. Nowadays, the periodical study on the performance of the research centers is an inevitable necessity in order to identify the effective factors on the performance appraisal of the relevant research centers. This study aims to identify the effective indices on evaluating the performance of the research centers. In this regard, we first distributed a questionnaire and analyzed the results and reached to 45 indices as the most important ones. Then we inserted these 45 indices into a final distributed questionnaire. To analyze the data and reduce the variables, we used factor analysis. Accordingly, 10 factors were identified as the most important factors in evaluating the research centers. These factors are as follows in order of their importance respectively: 1) scientific products; 2) achievements and awards; 3) research plans; 4) effectiveness; 5) scientific activities; 6) research resources and facilities; 7) commercialization and revenue; 8) management and organizational structure; 9) funds and credits; and 10) human resources.

Key words: Evaluation, Factor Analysis, Performance Evaluation, Performance Evaluation Indices, Research Centers.

INTRODUCTION

Nowadays, science and technology is a tool for wealth creation so that the income of the knowledge and technology is significantly higher than the income from sales of natural resources. Many countries have managed to be changed to very wealthy countries based on mere technology and knowledge while many countries have merely relied on their natural resources and gradually have lost their resources. Wealth creation on the basis of the technology is not a matter of choice, but it is the condition for survival in the global market (Bahreini, *et al*, 2007).

Most organizations are acting in a competitive and dynamic environment; an environment whose internal and external variables are continuously changing. Thus the prediction of such changes is extremely hard. On the other hand, the organizations spend lots of costs and times to prepare, compile, and implement the strategies to make them able to fulfill their long term goals and perspectives. Thus it is extremely important for the managers and organizations know how much the performance of the organization has led the organization to meet its goals and where is the position of the organization in today complicated and dynamic environment (Hasanzadeh and Zare, 2009).

The establishment of the performance evaluation system can make all processes under control. Some researchers such as Zarkesh and Beas (2004) believe that the performance evaluation is a part of the widespread movement of being responsible. Performance measurement shows that progress of the programs in comparison with predetermined goals in a continual and practical way. All organizations, including research centers need to establish the performance evaluation system in order to fulfill their missions and reach their goals. Performance evaluation requires some indices in itself to equip us to evaluate the performance of any organization. This system is indeed a road map from what *is* to what *has to be*. In other words, performance evaluation is not possible at any level unless we have a specific criterion for it (Babaei, *et al*, 1997).

2. Literature Review:

2.1. Evaluation:

In order to realize the scale of the desirability and the nicety of the activities, especially in complicated and dynamic environments, organizations will inevitably need a system of evaluation. On the other hand, the lack of the evaluation and control system in any organization will lead to the lack of connection between the internal and external environment of the organization whose consequence senility and finally the death of the organization. But the researches show that lack of a system for receiving the feedbacks makes the needed reforms for the development, growth and improvement of the organization's activity impossible (Tzeng, Chiang,

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and Li, 2006). The experiences show that the evaluation of different parts of the companies with different sizes, and the extension of such evaluations will have significant effects on the efficiency, innovation, performance, satisfaction, and successfulness of the relevant companies. If any given organization fails to look at it and have a good evaluation of its own activities, it will move toward the senility.

2.2. Performance:

Since the performance management deals with the wider issues of the business and its direction toward longer term goals, it will be considered as a strategic issue if the organization intends to act effectively on its surrounding environment (Armstrong, 2006: 2). According to Kaplan and Norton (2007), regardless of their activity environment, the organizations continually need to improve their performance and thus they have to do their best to reach the performance excellence. This point show the fact that performance evaluation is always a challenging problem for the management of the organizations and hence, it is extremely important to determine and explain suitable indices for evaluating the performance of the organization in order to fulfill the organizational goals and visions.

2.3. Performance Evaluation:

Performance evaluation is "the process of quantitating the efficiency and effectiveness of the given operations" (Neely and Platts, 2005). Indeed, performance evaluation is an assessment model to compare past plans and executions of strategies, operating activities and target establishment of organizations with executive abilities, participating rate and competing rate of employees. Furthermore, this assessment model is helping organizations to plan future strategies and set up performance targets of employees in order to achieve the final target of the entire organizations. Green and Keim (1983) stated that "performance evaluation is for achieving the entire target. It is based on the quantification standard made in advance or using subjective judgment to assess the result of daily operation; in the meanwhile, performance evaluation also possesses the function of amending responding policies and unifying the target of individuals and organizations" (Wu, *et al*, 2011).

Specifically, performance evaluations must be based on a set of objectives that are linked to the mission and the vision of the future. In addition, these evaluations must define the customers, the unique requirements, and the level of satisfaction that the organization needs to achieve (Wu, *et al*, 2012). This mechanism should not only equally evaluate both internal quality improvement and external benchmarks but should also evaluate factors that can be improved (AI-Turki and Duffuaa, 2003).

The subject of performance evaluation is one of the widest subjects on which a wide range of fields and theorists have had significant effects and there are lots of papers and reports on it. Moreover, many applied softwares have been developed for performance evaluation (Marr and Schiuma, 2003). But despite the availability of several models, frameworks and conceptual models in this field, the highest rate of effectiveness in this field belongs to the researchers (Marr and Neely, 2001). Performance evaluation has challenged the researchers and users for several years. In the past, commercial organizations used financial indices as the only instrument for evaluating their performance until Johnson and Kaplan studied and evaluated the management accounting systems in the late in 1980 and found that the information and data of such systems is insufficient for evaluating the performance of the organizations. They also found that the reason of such inefficiency is the increasing complexities of the organizations and competitions of the market (Kaplan and Norton, 1992).

Evans and Lindsay (2005) believe that the organizations that have a system of performance evaluation are the organizations with the following characteristics:

a) Financially, they are more likely to stand in the upper one-third rank of their industry;
b) They are more successful in conducting organizational evolution;
c) Their senior managers can come to an agreement upon their strategies of their organization;
d) They can reach a high level of cooperation and teamwork among their managers;
e) They are successful in conducting self-evaluation among their employees; and
f) Their employees are willing to take the risks.

Brown and Sevenson's researches (1998) show that the effective systems of performance evaluation of the research and development have the following characteristics: (a) their emphasis on the internal evaluation against the internal evaluation; (b) their focus on the results or outputs rather than the behaviors; (c) considering valuable results or outputs only; (d) the simplicity of application; and (e) the objectiveness and tangibility.

2.4. Performance Evaluation Indices:

The main components of each performance evaluation system are the indices and criteria of that system because the relationship between the model of the performance evaluation with the external and internal environment of the organization is created by the indices and the criteria. Indeed, any model of performance evaluation is formed by the performance indices and the relationship between their results. The important role of the indices in the suitable and proper performance evaluation is absolutely evident. In designing and selecting the criteria of the performance evaluation, the organizations have to consider some principles and frameworks.

The criteria have to be planned in such a way that they can secure the efficiency and effectiveness of the performance evaluation system, although in most cases, the organizations neglect this step and select the criteria that are not able to evaluate and assess the different dimensions of the organization at external and/ or internal levels and they fail to disclose the fundamental, hidden, and long term problems of the organization (Kaplan and Norton, 2007).

Prior studies have confirmed that key performance indices constitute the most comprehensive objectives in all organizations and that these indices can assist a manager to attain his or her goals (Amiz, 2010). Given their importance, key performance indices are significant factors in promoting quality improvement and goal fulfillment (Wu, *et al*, 2012).

Regardless the type of the system that is being used for the performance evaluation, it is necessary to exactly define the indices of the performance evaluator. These indices must be comprehensive and indicate the real performance of the studied research center. In fact, the indices are the instrument for assessing the performance.

2.5. Performance Evaluation in Research Centers:

In the period of the rapid changes and increasing competition over the rare resources, the periodic evaluation of the performance of research institutes and centers in order to identify their problems and weaknesses is more necessary than before. Moreover, the public research centers have to be responsible against their planner authorities and financial supporters and justify the quality of their activities and prove their tendency toward the improvement and compatibility (Peterson, *et al*, 2003).

According to Paddock (1997) and Hingoft (2000), performance evaluation is the process of assessing and measuring the performance of the executive agencies in the framework of the principles and concepts of the science of management in order to fulfill the organizational goals and tasks in the form of some executable programs. Moreover, Halachmi (1999) believes that the assessment of the performance of public services is a systematic attempt in order to realize the scale of responsibility of the public services against the needs of the people and the ability of the government in meeting such needs. In a research on the characteristics of the evaluation system and performance management in public organizations, Sole (2009) extracted and presented the effective factors on the improvement of the performance of the public sector. His research includes the study and analysis of the dimensions of performance and using performance indices and the factors that affect the implementation of the performance management process.

In yet another research to evaluate the performance of national R and D organizations in India, Banwet and Deshmukh use the efficiency measurement of the organizations through some indices that had been defined in the evaluation of the outputs of R and D organizations to evaluate the performance such organizations. The results of this research showed that the assessment of the efficiency for R and D organizations have to be based on the qualitative and quantitative indices because of both of these two sets of the indices are considered in the research, the results will be more comprehensive and more realistic in evaluating the organizations and will provide more suitable tools of decision making for the managers in order to identify their needed criteria for evaluating the efficiency of their relevant organization and separate inefficient organizations from the efficient ones.

The important fact is that the research and development and the performance of the research organizations have to be evaluated with a suitable approach. The approaches toward the performance and efficiency assessment of the research and development determine the direction and the way of the integration of the related evaluation. Thus it is necessary to describe and interpret the approaches of the performance assessment of research and development. This necessity makes the evaluation, especially the evaluation of the performance of public research centers complicated (Ozgediz, 1999).

The performance of research organization, like any other official organization, is affected by the variation of external environment and the variety of inter organizational environment. Moreover, in the research organizations, the role of the human resources management is extremely important. Jane and Triandis (1997) believe that any research organization is based on four fundamental axioms, including creative space (offering new ideas), intelligent human resources, suitable cultural base, and financial support. Creative space is a suitable space for offering and creating new and constructive ideas. To create the ideas, persons have to be qualified and expert in one or some field and have the ability of conceptualization. To make a space for creative thinking, the organization has to build the needed suitable grounds. Alter (2005) believes that the organizations have to pay especial attention to prepare a suitable environment for the jobs of researching and information processing, although such a preparation may be difficult and expensive.

Another valuable base of the research centers includes intelligent human resources. In any given research center, the persons are more successful who have a curious, analytical, and thinker's mind. Such persons have usually a high educational degree or specialty (Alter, 2005). They create some innovations and strategies that can secure the economic performance and competitiveness of their institute (Davenport, 2005).

As another base of the research centers, organizational culture is a combination of values and beliefs of the organization member. This culture can be appeared in the improper regulations and the behavioral expectations within the organization. This organizational culture is usually the result of the current policies of the organization and it supports the organization by the values and believes (Bolton, 2006). Doing research activities need considerable resources. Attracting the capable researchers and providing the research facilities and equipment is not possible without sufficient financial support. On the other hand, attracting the financial support for the research issues can be a way of testing the reactions of the market and users against the outputs of the researches and consequently, against the effectiveness of the relevant organization (Jane and Triandis, 1997).

A review of the results of studies on the performance of research centers shows the effects of some individual and organizational variables on the performance of research centers. In this regard, the results of Bartlett's study on some research centers (2002) show that some factors like the scale and type of the research activities are effective on the research performance of the researchers. Moreover, some other factors such as the amount of the salaries and the scientific rank of the researchers are effective on the research performed as well. According to Teodorescu (2000), other variables that affect the research performance of the researchers include the scale of obtaining the trainings in relation to the research skills, attending in the scientific conferences, and being the member of professional societies and associations. On the basis of the results of his own study on the research centers, Brocato (2002) presented a model in which some psychological and sociological characteristics of the researchers along with the environment of the research organization have an effective role on the research performance.

According to Bland, *et al*. (2005), the research performance of the researchers in their related centers is highly affected by the individual and organizational factors and the current leadership style of that research organization, and indeed, the research performance is the result of the interaction of these three variables.

To assess the effective performance of research centers we have to study them as a subsystem of a bigger system. Accordingly, the achievements of the research center have some consequences for the bigger system or for the society at large. These consequences have to be studied as the results of the research center.

The way of measuring the research and development departments can be highly affected by the expectations that have been determined in the guidelines of the organization. Thus according to Brawn and sevens on (1998), in any effective system, in measuring the performance of the research centers,

- The focus has to be put on the external measurement instead of the internal measurement; and
- The focus has to be put on the results and outputs instead of the behavior.

3. Research Question:

Since this research is an explorative research in nature and it does not necessarily need to explain a hypothesis, we will attempt to answer the following question: what are the most important indices and factors in evaluating the performance of the research centers?

4. Methodology:

Regarding its subject and objectives, this research is an exploration in type and its methodology is based on the survey. Additionally, in this research we have used the knowledge and profession of the managers, experts and professors of the research institutes and centers in completing the questionnaires of the research. To analyze the data of the research for extracting the effective components on the performance of the research centers we have relied on the concept mapping method. Indeed, this method is a reflection of the thinking of the group on the study subject and the way of connection between the ideas and the scale of their importance. Concept mapping is a suitable combination of deductive and inductive procedures. In other words, this method includes expert group and Delphi method and covers the survey and statistical approaches; hence the concept mapping method is highly valid.

4.1. Data Collection Method:

First Step: Identifying The Indices:

According to the literature review, research centers face several problems in defining performance indices among which they have to find the different performance indices within the research centers and they have to select a criterion for these performance indices. Thus in the first step we dealt with collecting all introduced indices in the research literature. In this regard, we studied several books and journals and on the basis of the theoretical and experimental foundations, we identified and extracted 135 indices among the most important offered indices in the field of performance evaluation of the research centers and institutes.

Second Step: Selecting the Most Suitable Indices:

In this step, we send the identified indices to the experts, professionals, and managers of the research centers to study them and assign them the needed scores and specify their importance coefficients in order to

identify and select most important indices. After collecting the set of the indices, their assigned scores were analyzed through one-way ANOVA analysis. According to the obtained means, the indices that obtained a score more than the total mean (78.83), were selected as the more important indices. According to the obtained results of this step of the research, the number of 45 indices remained as the most important indices that have the most congruence and efficiency for evaluating the performance of the research centers and so they went to the next step.

5. Data Analysis:

Regarding the type of the research and its objective, we used factor analysis in order to analyze the final data and reduce the number of the variables to the factors and prioritizing them. There are four main steps in factor analysis as follow:

a. Collecting the data and preparing the related correlation matrices;
b. Extracting the preliminary factors;
c. Rotation to obtain a final answer and its interpretation;
d. Creating factor matrices and using them in further analysis (Kim and Muller, 1999).

5.1. Collecting the Data and Preparing the Related Correlation Matrices:

As explained before, we obtained 45 indices from the analyses in previous steps to be used in the final analysis and extracting the factors that include this set of indices. It is to be mentioned that we first calculate the correlation coefficients and analyze the variables that were correlated with the other variables.

5.2. Extracting the Preliminary Factors:

There are different ways to summarize or reduce the variables. One of the usual ways is to make a linear combination of the variables that assign the most change variable to themselves. In such a case, we can calculate the variance between the observations in a smaller scale with lesser calculations using new variables. One of the main objectives of factor analysis technique is to reduce the dimensions of the data.

5.2.1. Kaiser- Meyer-Olkin (KMO) Test:

In this research we calculated KMO statistic in order to find if factor analysis is admissible and if the sampling is congruent. This statistic is an index for comparing the values of simple and partial correlation coefficients on all variables. Inserting the data in the studied model, the KMO was obtained as 0.918 that admits the factor analysis in an excellent level. Bartlett's Test of Sphericity explains the authenticity of the factor analysis model. Bartlett's test that is judged with the significance level is significant with the 1225 degrees of freedom. This degree of freedom shows that correlation matrix is not equal to zero in society.

5.2.2. Communality Table:

This table is a summary of communality of the variables in factor analysis without any rotation and shows the suitability of the type of the variables in the factor analysis process. It is to be mentioned that if the number value of the communalities is equal to at least 0.5, then they will be acceptable. The value of the communalities of all variables of this research was higher than 0.5 and thus they are suitable for factor analysis.

5.2.3. Total Value of Explained Variance:

This table shows that the available variables are converted into how many factors and how many percent of the relevant variance is explained and covered. Besides, it shows the validity of the questions. After the matrix of preliminary factors was calculated, it was specified that totally 10 factors have an Eigenvalue of more than 1 and have covered 90.818 percent of the variance of all variables.

Table 1: Total explained variance covered by the 10 extracted factors.

Component	Initial Eigenvalues	Variance (%)	Aggregated Variance (%)
1	13.727	30.505	30.505
2	9.237	20.527	51.032
3	4.145	9.210	60.242
4	2.790	6.201	66.443
5	2.759	6.130	72.573
6	2.552	5.671	78.244
7	1.986	4.412	82.657
8	1.465	3.256	85.913
9	1.148	2.551	88.464
10	1.059	2.353	90.818

5.3. Rotation to Obtain A Final Answer and its Interpretation:

We made some rotations and changes on the factors to make the components have a better interpretation of the data connections. In many cases where several variables depend on one or even some specific factors, it will be difficult to interpret the factors. Thus, some methods have been invented to simplify the interpretation of the factors without changing the communalities. Table 2 shows the component matrix and shows the factor weights of the variables after the rotation (in Varimax Rotation Method) factor weights are the correlation coefficients of the factors.

Table 2: Rotated component matrix in varimax rotated method.

#	Indices	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10
1	Q1					.793					
2	Q2					.590					
3	Q3					.766					
4	Q4	.955									
5	Q5	.932									
6	Q6	.908									
7	Q7	.836									
8	Q8	.898									
9	Q9	.685									
10	Q10	.695									
11	Q11		.545								
12	Q12			.713							
13	Q13			.631							
14	Q14			.541							
15	Q15			.586							
16	Q16			.787							
17	Q17				.522						
18	Q18							.929			
19	Q19							.889			
20	Q20				.571						
21	Q21		.203								
22	Q22	.812									
23	Q23	.903									
24	Q24						.613				
25	Q25						.910				
26	Q26				.733						
27	Q27						.582				
28	Q28						.845				
29	Q29								.917		
30	Q30								.978		
31	Q31								.801		
32	Q32								.929		
33	Q33								.734		
34	Q34								.733		
35	Q35								.759		
36	Q36										.781
37	Q37										.921
38	Q38										.777
39	Q39										.619
40	Q40				.858						
41	Q41									.696	
42	Q42										.865
43	Q43									.661	
44	Q44									.558	
45	Q45									.762	

It is to be reminded that in order to study the nature of the relationship between the variables and in order to reach to the names and definitions of the factors, some researchers consider the coefficients higher than 0.3 and sometimes higher than 0.4 as significant coefficients in defining the factors; and consider other coefficients with lower value as the zero coefficients (random factor). In this research we considered the value of 0.4 as the least value of the coefficient and thus, variable 21 which is located in second factor with the coefficient of 0.203 was considered as the random factor because its value was less than 0.4 and consequently it was deleted. Hence in the analyses of the next step we will not use it and our analyses will be continued with 44 indices.

5.4. Creating Factor Matrices and Using Them in Further Analysis:

Naming any factor typically depends on the exact investigation of what the variables measured with high factor weights. Another way does exist: the researcher has to scrutinize the Communality of the variables (Kim

and Muller, 1999). The factors are being named on the basis of the definition of the variables and what common fact they assess.

6. Factors:

6.1. Factor 1: Scientific Products:

This factor with the highest percentage of the total variance, i.e. 30.505%, has been named as *scientific products* and includes the following variables:

Table 3: Factor 1 and its variables explained.

#	Explanations	Factor weight
1	Number of published articles of the researchers of the center in the scientific research journals	.955
2	Number of published articles of the researchers of the center in the scientific promotional journals	.932
3	Published articles of the center's researchers in indexed ISI/ ISC journals based on the research plans	.908
4	Scientific has ranked of the published journals of the center	.903
5	Quality of the published articles by the center's researchers (knowledge production, number of references to the published articles about the center, content quality, etc.)	.898
6	Presented articles of the center's researchers at national and international conferences	.836
7	Index of the center's journal in ISI/ ISC	.812
8	The quality of the books published by the center (number of references to the published books, content quality, publish quality, etc.)	.695
9	A number of the books published by the center's researchers	.685

6.2. Factor 2: Achievements and Awards:

This factor with the variance value of 20.527% has been named as *achievements and awards* and includes the following variables:

Table 4: Factor 2 and its variables explained.

#	Explanations	Factor weight
1	Gaining the awards of creditable festivals and research- scientific events (such the research week, the week of the book, etc.)	.454
2	The quality of the achievements (obtaining the expected result)	.203

6.3. Factor 3: Research plans:

This factor with the variance value of 9.210% has been named as *research plans* and includes the following variables:

Table 5: Factor 3 and its variables explained.

#	Explanations	Factor weight
1	The ratio of operationalized projects to the total completed projects	.787
2	Scale of research plans (in-progress projects, new projects, and completed projects)	.713
3	Applicability of the research plans	.631
4	Completing the projects with predicted costs	.586
5	Completing the projects in predicted time	.541

6.4. Factor 4: Effectiveness:

This factor with the variance value of 6.201% has been named as *effectiveness* and includes the following variables:

Table 6: Factor 4 and its variables explained.

#	Explanations	Factor weight
1	Social status and job satisfaction of the center's scientists and researchers	.858
2	Users' satisfaction with the research achievements	.733
3	Accuracy in assessing the necessity of implementing research plans	.571
4	Compatibility scale of the conducted national researches to the objectives of development programs	.522

6.5. Factor 5: Scientific Activities:

This factor with the variance value of 6.130% has been named as *scientific activities* and includes the following variables:

Table 7: Factor 5 and its variables explained.

#	Explanations	Factor weight
1	Membership in professional scientific societies and associations	.793
2	Having cooperative agreements and contracts with the universities, research centers, and public administrative organizations	.766
3	Administrating national and international conferences and symposiums	.590

6.6. Factor 6: Research Resources and Facilities:

This factor with the variance value of 5.671% has been named as *research resources and facilities* and includes the following variables:

Table 8: Factor 6 and its variables explained.

#	Explanations	Factor weight
1	Having data bases and computer networks for scientific information and being connected to the internet networks	.910
2	Having an evaluation system (in order to conduct periodic and continual self-evaluation by the research center	.854
3	Being subscribed in databanks	.613
4	Development of information technology in the research center	.582

6.7. Factor 7: Commercialization and Revenue:

This factor with the variance value of 4.412% has been named as *commercialization and revenue* and includes the following variables:

Table 9: Factor 7 and its variables explained.

#	Explanations	Factor weight
1	The capability of commercializing research plan	.929
2	Income- generation of the center by selling or transferring the technologies resulting from the research	.889

6.8. Factor 8: Management and Organizational Structure:

This factor with the variance value of 3.256% has been named as *management and organizational structure* and includes the following variables:

Table 10: Factor 8 and its variables explained.

#	Explanations	Factor weight
1	The direction of the organization toward short term and long term goals	.978
2	Creating internal leadership within the research center (the individuals' commitment to the goals, being responsible for the results, etc.)	.929
3	The direction of the organization toward its vision and mission	.917
4	Suitable grounds and structures of the research in the center	.801
5	Specialty of the leadership in the center (relevance of the obtained educational diploma, proficiency and the experiences of the leader in the field of the activities of the center	.759
6	Quality of the management in center (way of programming, organizing, conducting, and controlling the center by its management)	.734
7	Suitable organizational structure (paying attention to the principles of organizational structure such as the flexibility, etc.)	.733

6.9. Factor 9: Funds and Credits:

This factor with the variance value of 2.551% has been named as *funds and credits* and includes the following variables:

Table 11: Factor 9 and its variables explained.

#	Explanations	Factor weight
1	Public credits absorbed by the research center	.762
2	Per-capita payments to the researchers	.696
3	Assigned financial resources to RandD in the center	.661
4	The credit of the signed research contracts	.558

6.10. Factor 10: Human Resources:

This factor with the variance value of 2.353% has been named as *human resources* and includes the following variables:

Table 12: Factor 10 and its variables explained.

#	Explanations	Factor weight
1	Professional level of the human resources of the center	.921
2	Number of the professional researchers of the center	865
3	Training the researcher human resources	781
4	Number of the researchers who are the academic members of the universities	777
5	Attracting the prominent postgraduates	619

7. Findings:

Considering all the above mentioned points, we can introduce the 10 factors obtained from the results of the research as the most effective factors on evaluating the performance of the research centers as shown in figure 1.

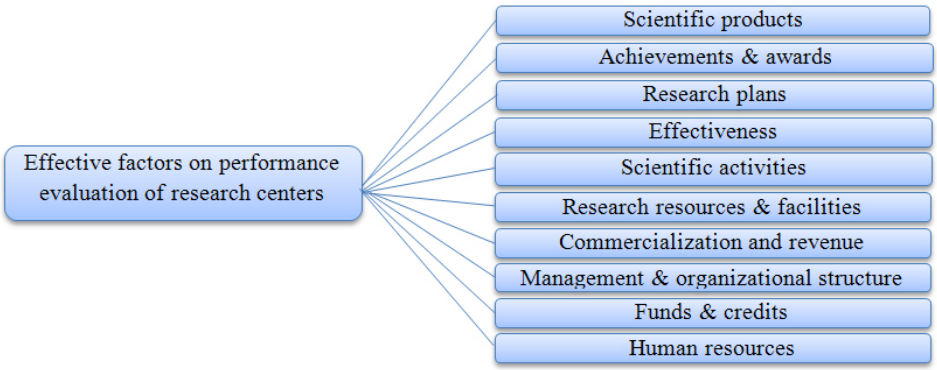

Fig. 1: Final effective factors on the performance evaluation of research institutes.

8. Suggestions:

Each of the 45 identified indices of this research as the indices of performance evaluation of research center implies the effect of these indices on evaluating the performance of such centers. The necessity of paying attention to each of these indices can be considered as an important index in performance evaluation. However, in order to emphasize some of these cases, at the following we will offer some suggestions about some of the identified factors.

8.1. Scientific Products:

- Some amount of money have to be paid to the researchers whose articles have been accepted or published in creditable national or international journals, in order to encourage such researcher for their role in promoting the scientific position of their university and country.
- Some amount of foreign exchange has to be paid to the researchers who publish their articles in the international creditable journals. This foreign exchange can be paid as the page charge.

8.2. Achievements and Awards:

- Considering the national commitment for developing the scientific Centers of Excellence" at the national level whose goal is to reinforce the competitions, innovations and quality standardization, the official authorities have to support the researchers and scientists in full.
- Developing and promoting the creditable awards and festivals are clear representations of such systematic supports.

8.3. Research Plans:

- To avoid the repetition of the research by comprehensive search in the scientific databases for each plan and project, and to study and to professionally document the history of the research at a wide national and international levels to ensure the necessity of conducting new research before the plan and project is officially approved.

8.4. Effectiveness:

- Considering the role of researchers' satisfaction in fulfilling the objectives of the research centers, it is necessary to obtain the researchers' satisfaction as a strategic policy of the institute.

8.5. Scientific Activities:

- Preparing some training opportunities and participation of the researchers in scientific societies, because such participations are good opportunities to communicate the ideas about the subjects and methods of research and will have an effective role in promoting the performance of the research centers.
- Considering the effects of the researchers' participation in the scientific seminars and societies, the research centers have to help their researchers attending in such events.

8.6. Commercialization and Revenue:

- Establishing some parallel organizations and institutes with the mission of promoting the commercialization of the researches
- Modifying and revising the regulations and policies on distribution of the obtained income from the commercialization of the knowledge in order to motivate the researchers to be involved in the process.

- Creating some associations, societies, networks, and other communicating grounds to increase the relationships between the activists of industries, universities, investors, and all individuals who play roles in the process of commercializing the knowledge.
- Establishing databases to collect the needed information about the needs of the industries, technologies, universities, and about the providers of financial and non-financial supports for implementation of the new technologies.

8.7. Management and Organizational Structure:

- The managers of the research centers have to apply some specific policies and plans to correct the behavior of the management and the organizational behavior and culture of the research centers and to change the current atmosphere to an atmosphere where the modern and creative ideas and thought are being supported and nurtured.
- Preparing suitable ground for emerging and nurturing the new ideas, thoughts, and plans. These issues are an indicator of the dynamic management in research organizations. Offering new ideas is a window toward doing new activities and it has a significant role in detecting and solving the problems and challenges. Such a point is vitally important in the research centers whose main function is to think to the available solutions relying on the efficient and new methods.
- Participation of the employees, especially the researchers in order to run the innovations in all affairs of the organization (including in the inputs, outputs, processes, strategies, etc.). Such participation will increase the loyalty of the employees to the organization and reinforce their satisfaction with the teamwork in the organization.
- Research centers have to create a knowledge management in order to reinforce the intellectual infrastructures and information of the organization in confronting the opportunities and threats, and in changing the threats to the opportunities and exploiting such opportunities in innovative ways. Through the increasing reinforcement of such knowledge management, the organization can guarantee their survival and growth.

8.9. Funds and Credits:

- Eliminating the limitation of the funds of research centers is another suggestion because the limitations of the funds will lead to rejection of some proposed research plans or the reduction of funds of research plans increasingly due to the limitation of the funds. Thus it seems necessary to eliminate any ceiling for funds of research centers in order to welcome research plans of the academic members regardless of their supposed needed funds.

8.10. Human Resources:

- It is necessary to apply scientific principles of the "human resources planning" or to nurture and develop the human resources and to identify and analyze suitable human resources and regulate suitable strategies in this regard.
- It is necessary to create a coherent and coordinated vision about the prediction, attraction, supply, improvement and preserve the human resources in the research centers. Such a vision requires establishing a department of "Human Resource Planning" (HHR) in the research centers to systematically predict the coming needs of the center for human resources supply and demand.

8.11. Other Suggestions:

- It is suggested to establish a National Innovation System (NIS) in the country to define and explain the national research goals and to specify the research priorities of the country.
- Interviews with the experts show that the existential philosophy and the organizational values of any research institute can have a very effective role in weighting and prioritizing the related sub-criteria. Thus it is suggested that considering its existential philosophy and the functional objectives, each of the research center are being supported by a related authority or ministry. The financial support of these authorities not only can benefit the researcher and his/ her institute, but it can benefit the whole society at large and it can lead to the development of efficiencies of the researches.
- According to the available studies, the main problems of research in Iran include the problems of policy-making, support of the researches, and the organization of the researches. But currently the most important problem of the research is the reduction of time cycles and research budgets. Several factors have led to the failing of research in Iran, among which one can refer to supporting problems, shortage of space and facilities, shortage of related educational and consulting services, lack of motivation in the researchers, lack of a stable environment, lack of suitable supporters, etc. On the other hand, the current gap between the real research needs and the research projects (in other words, the gap between the researchers and their customers) is another reason

for the failure of the research in Iran. in this regard, following suggestions can be offered to resolve mentioned problems:

- Preparing databanks in the fields of research organizational and administrative structure, quality management, research efficiency, and application of the databanks in the researches.
- Specifying the keywords and concepts on the research organizational and administrative structure and research process on the basis of the databanks and extracting the summary of the related topics from the databanks
- Planning the quality in the research organizations on the basis of specified keywords and concepts. This method includes the followings:
  - Defining the products and customers for the research organization
  - Determining the needs for quality and integrating these needs in a system of research quality
  - Specifying the operational steps and operational communications in the research organization (quality circle) in parallel to the quality circle of standards of ISO 9000
  - Identifying the mechanisms for improving the quality in the organization.

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