

Performance Evaluation of Enterprise Architecture Using Balanced Score Card: A Case Study

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ABSTRACT

Enterprise performance evaluation methods play an important role in improvement and development of enterprise architecture. Balanced evaluation has attracted the attention of the managers and scientific management circles as an efficient mean for implementation and realization of enterprise strategy.

In this research, role of enterprise performance evaluation is studied by using reference models, identifying enterprise architecture components' relations, and using balanced score card. It is also expressed that organizations, while implementing their strategy, can identify their current status by implementing modern evaluation methods. The presented balanced evaluation method allows us to elaborate and translate intangible assets of an organization and its current status, and eventually, with study of the results and use of correction and change methods, provides opportunity for successful execution of strategies.

KEYWORDS: enterprise architecture, balanced score card, enterprise architecture evaluation

1- INTRODUCTION

At present, broad changes have been made in markets, customers, enterprise performance systems and their management methods. On the basis of these drastic changes, the most important subject for private and public companies and organizations is to survive in such competitive environment. One of the most important factors for keeping a competitive edge is performance evaluation which has turned into a critical case (Ebrahimi Sar Alia and Mohseni Sharif, 2009).

Nowadays management of organizations based on strategic management is the only solution for creation of competitive value and advantage. Therefore, performance should be measured through evaluation and measurement of success in progression of strategies (Namazi, 2003). In this regard, enterprise architecture can play an important role as enabler. The broad range of definitions for enterprise architecture in its literature indicates that not only enterprise architecture is a new subject, but also that its emergence is closely related with business and information technology perspectives (Winter, R. and Fischer, 2006). Generally, Enterprise Architecture can be defined as "An enterprise map which describes the structure of mission and required information for the enterprise, and necessary technologies for supporting them and also defines transient process for implementing these technologies" (Cio Council, 1999).

In this research, after describing the three main concepts of enterprise architecture, performance evaluation, and balanced score card, the proposed method is adapted in the case study and eventually promotion of balanced score card method, as one of enterprise performance evaluation methods, is analyzed.

2- Enterprise architecture process

The goal of enterprise architecture process is to create and execute the architecture and provide architecture outputs in the organization. This process is put beside other main processes of the organization and executed continually. Generally, this process includes three main stages which are 1- strategic planning of information technology 2- enterprise architecture planning, 3- execution of enterprise architecture. Strategic planning of information technology is a base for enterprise architecture planning. During this stage, Vision, long term and short term goals, and opportunities of the organization in information technology are extracted (Cio Council, 2001)

Stages of enterprise architecture

A: Status quo architecture, B: Desired architecture, C: Transition Plan

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With regard to the fact that enterprise architecture can be divided into three general classes of status quo architecture, desired architecture, and transition plan (Zachma, 1987), a method or framework of enterprise architecture evaluation should consider the following items in its enterprise architecture plan.

1) Status quo architecture evaluation

Status quo architecture includes a set of descriptions which show current state of the organization in terms of missions, working processes, and technology infrastructures (Feaf, 1991). Status quo architecture includes the following sub-architectures.

A- Profession architecture (current), B- Data architecture (current), C- applied systems architecture (current), D- technology architecture (current). Therefore, enterprise architecture plan evaluation method should evaluate all sub-architectures of the status quo architecture of the organization and their interactions.

2) Desired architecture evaluation

Desired architecture includes a set of descriptions which show future and desired state of the organization (Feaf, 1991). It contains the following sub-architectures:

A- Desirable working architecture, B- Desirable data architecture C- Desirable applied systems architecture, D- Desirable technology architecture. Therefore, enterprise architecture plan evaluation method should evaluate all sub-architectures of the desired architecture state of the organization.

3) Transition Plan evaluation

Transition strategy is a plan which shows the strategy and time plan necessary for transferring the organization from status quo to desired state (Feaf, 1991). Transition strategy process includes the estimation of effects of implementing desired architecture on organization, planning for creation of the required enterprise infrastructure, planning for implementation of desirable architecture components, and identification of hazards. Therefore, enterprise architecture evaluation method should evaluate constituent components of transition strategy.

3- Evaluation in management

Business units' Performance evaluation has always been one of the main concerns of managers and authorities of these units (Kaplan and Norton, 1996). Importance of performance measurement for the organizations has been identified and plays an important role in both private and public sectors, because, by evaluating performance, it helps clarify the organizations (Proper and Wilson Dobra, 2003).

Kaplan and Norton (1996) announced that for a thorough performance measurement an organization has to be assessed from four perspectives.

- 1- **Financial perspective:** financial indexes are one of the important components of balanced score card and this perspective tells us what results and financial achievements will finally be attained from successful realization of the goals which have been determined in other three perspectives.
- 2- **Customer perspective:** Profit is gained from customers; therefore, two fundamental questions should be answered: First, who are our target customers? What are our proposed values for them?
- 3- **Internal process perspective:** In this perspective, organizations should specify the processes with which they can continue creating value for their customers and consequently their shareholders.
- 4- **Learning and growth perspective:** How can the ambitious goals determined by internal process perspective, customer and consequently shareholders', be realized? When goals relating to customers and internal processes perspectives are determined, the gap between required skills and capabilities of the personnel and present level of these skills and capabilities becomes visible.

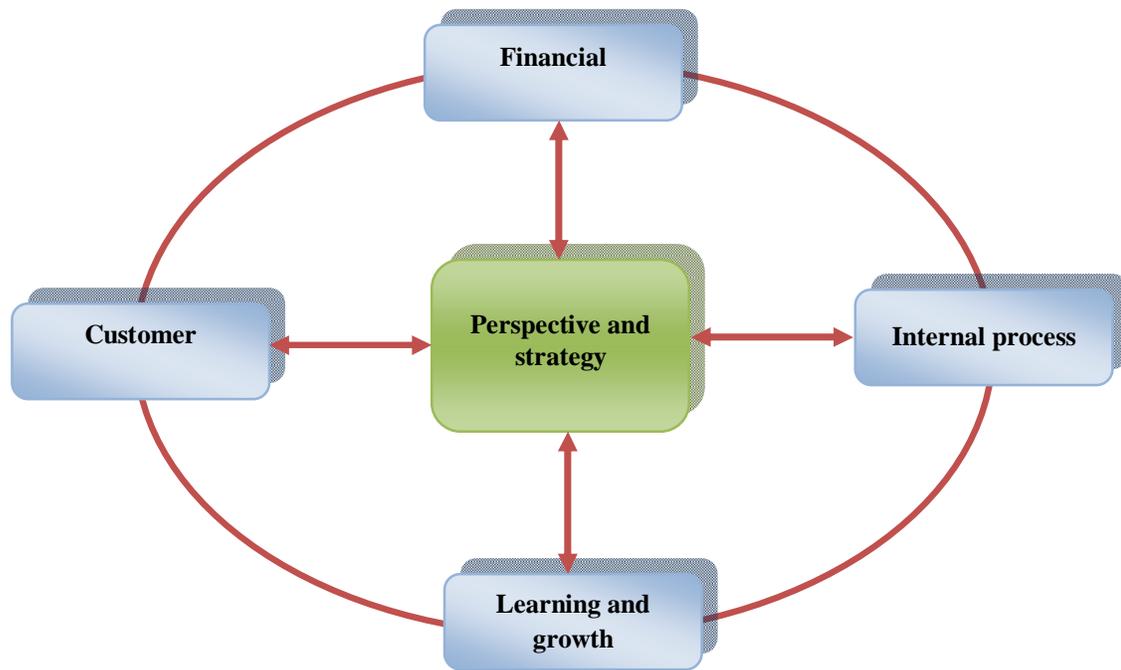


Figure 1: framework of balanced score card

As shown in figure 1, important point about these perspectives is that their core is the perspective and strategy of the organization. It means that goals and measurement criteria which are determined in these four perspectives originate from the strategy.

4- Introduction of enterprise architecture balanced score card and its dimensions

The general model of balanced score card is devised for a basic financial institution. Therefore, it should be slightly modified proportional to the application and the target entity. In the first step, aspects or dimensions corresponding with activity method should be identified in relation to its application in enterprise architecture.

In fact, each organization should invest and plan for having a suitable architecture, mainly and generally in the four main aspects of business -information, processes, applications, and technologic infrastructure (Shahrabi , 2009). As shown in figure 2, it seems that the most suitable aspects studied for making balanced score card perspectives proportionate in order to evaluate enterprise architecture are the four main fields considered by most enterprise architectural frameworks.

In figure 3, the mapping of these perspectives is shown. According to the figure, the most important aspect which every management and non-management system is utilized for its promotion in every organization is the business perspective and it has replaced the financial perspective in balanced score card classic model. Another aspect which is very important in measuring whether an architecture is suitability or not for the organization is attention to information perspective in the organization. Other aspects which are in the next layers are processes and applications and finally technology infrastructure.

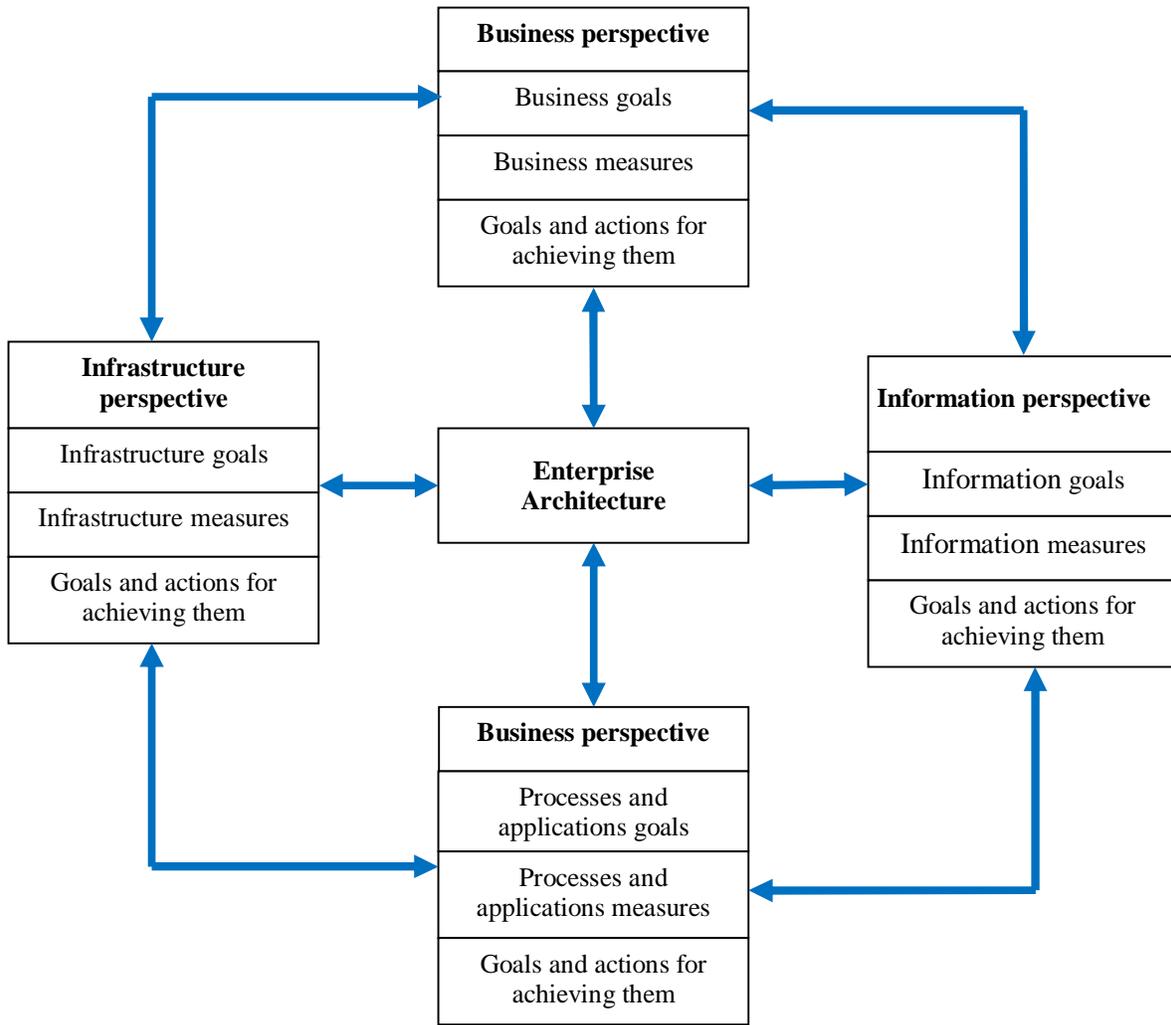


Figure 2: enterprise architecture evaluation model with balanced score card approach

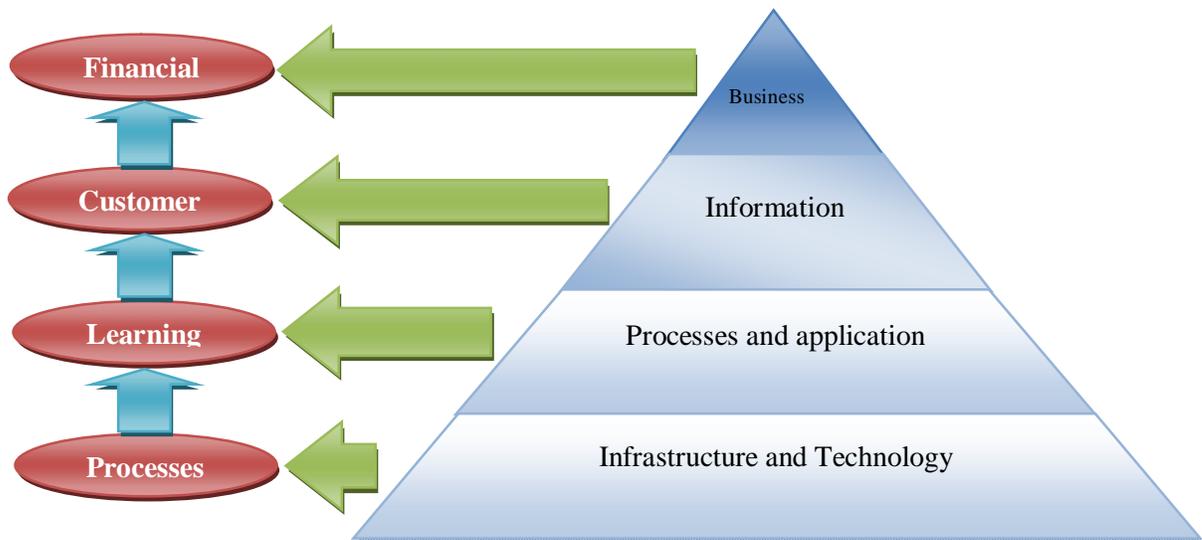


Figure 3: mapping enterprise architecture balanced score card dimensions

Business perspective: business layer means working processes of the company which are necessary for achieving mission, goals, and strategies of the company. Generally, reaching business goals and strategies in the organization is the main concern and all of organizations' efforts and utilization of all management and evaluation systems are to realize these goals. In fact, enterprise business strategies specify enterprise's orientations in all current and future activities. Enterprise architecture is also executed in order to provide suitable information and communication technology opportunities in the organization to support these strategies.

Information perspective: Before information is defined, meaning of data should be specified: "data is a group of symbols, words, and numbers which carry particular meanings and are obtained through observation and research and have not been processed yet; for instance history, number of a company's personnel, salary list details, etc. These symbols are obtained through internal or external sources and to better understand them more explanation is need." These explanations are produced by processing operational data. In fact, processing the data causes it to change from its raw form into sets of targeted concepts which called information.

"Therefore, information is processed data and meaningful facts which describe and define data so that the receiver can understand and interpret its message. In fact, based on the users' requirements, data is broken down and after it is classified, calculated, corrected, and summarized, it is converted to information. Fitness with time and conditions, accuracy and understandability are some of the main specifications of the information."

The main focus of enterprise architecture in two layers or edges is respectively on processes and information; therefore, it can be said that in this approach identifying the type of information required for the processes, sources of this information, and the way it is exchanged in the organization, is very important. In enterprise architecture, information layer is studied by study of title, sources, and how information topics are exchange in the organization. Information is the memory of an organization and produced as forms, reports, financial documents, notarial deeds, and etc. and kept and updated manually or by computers.

Processes and Application Perspective: Process is a set of activities which is executed in response to an event or stimulus and usually leads to a result; for instance, shopping process is done in response to goods request event and results goods delivery to the applicant. Any organization should have well-defined, standard, integrated, and etc. processes. One of the most important aspects of enterprise architecture is the reintegration of applied systems and processes of the organization, followed by substantial flow of work and information. It is in applied systems that information systems of the company (such as financial and personnel plans, quality control, office automation, budgeting, etc.) are recognized. These plans allow extraction of data and its conversion to the required business information.

Technologic Infrastructure Perspective: infrastructure and technology are regarded as the most basic enterprise architecture perspective. In fact, infrastructure and technology perspective provide the opportunity for implementation of enterprise processes and procedures in order to achieve enterprise goals. In infrastructure layer, data distribution's and information systems' status of the organization and configuration of technology facilities are specified and standards are defined which will be utilized for future application and development of various applicable technologies in the organization. These standards help unify the components and systems and increase their interoperability and integration.

Applied Algorithm for Enterprise Architecture Balanced Score Card

In figure 4, operating sub-algorithm and its adoption procedure are shown to help the architecture evaluation teams in the organization step by step. In spite of efforts to provide a comprehensive and inhibiting algorithm for evaluation, any organization can apply other complementary steps and actions with regard to its own enterprise architecture and special position. Finally, the following algorithm including seven steps is suggested:

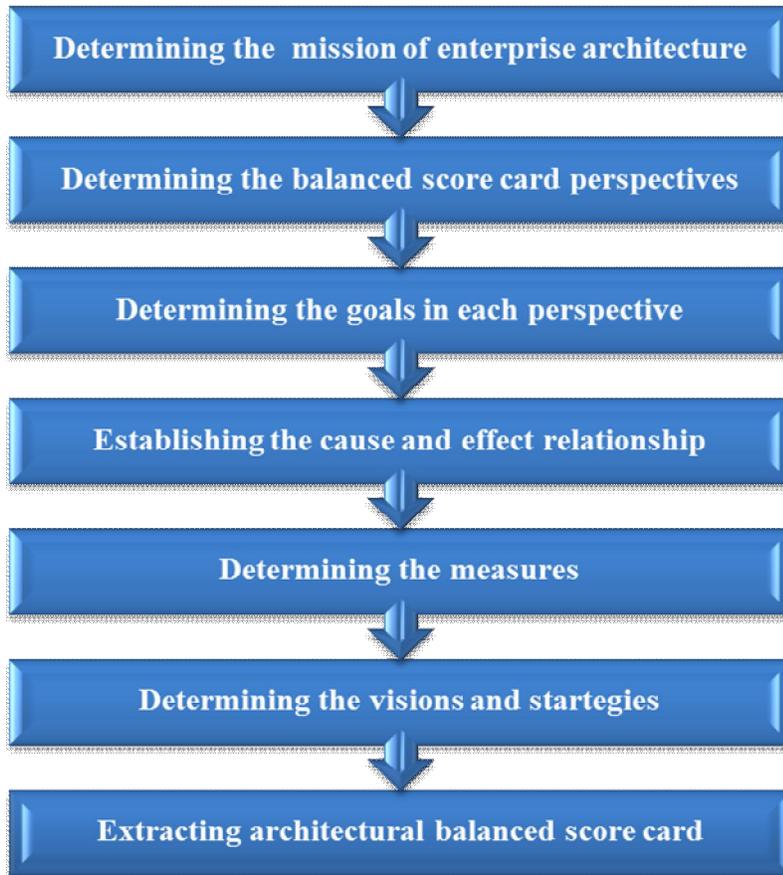


Figure 4: applied algorithm for enterprise architecture balanced score card

5- Case study

The main goal of this research is to study enterprise architectural performance evaluation with use of balanced score card in International institute of earthquake engineering and seismology. In this research, the statistical society is International institute of earthquake engineering and seismology in Iran including the organization’s experts, faculty members, experts, and senior experts. Out of whom, due to limitations, an adequate number of experts were selected (approximately 50 people). Cronbach’s alpha reliability coefficient was used to test the reliability of the questionnaire. When alpha is between 0.7 and 0.9, it is concluded that questionnaire has sufficient validity. In this research, as shown in table 1, the obtained alpha is 0.884; indicating that the questionnaire has sufficient validity.

		N	%
Cases	Valid	49	100.0
	Excluded ^a	0	.0
	Total	49	100.0

a. Listwise deletion based on all variables in the procedure.

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.884	.885	41

Table 1- reliability of questionnaire

In order to measure content credibility of the questionnaires and research’s validity, opinions of specialists and exerts in enterprise architecture were used. As mentioned before, model perspectives were stated as business, information, processes and applications, and finally technology infrastructure and by performing pilot studies International institute of earthquake engineering and seismology was selected among other

organizations because of its consistent and optimal enterprise architectural plan. In order to evaluate performance, architectural evaluation algorithm steps were performed on the target organization. For this reason, goals and measures of balanced score card were extracted in International institute of earthquake engineering and seismology. Experts' questionnaire, including 41 questions about goals and 62 questions about measures, tested the opinion of experts and goals and measures of balanced score card in International institute of earthquake engineering and seismology were ranked and classified with use of Technique of Order Preference by Similarity to Ideal Solution (TOPSIS). In accordance with the above mentioned material, four perspectives of business, information, processes and applications, and technological infrastructure were established and respectively 9 goals and 14 measures, 10 goals and 16 measures, 13 goals and 18 measures, and finally 9 goals and 14 measures were identified for these perspectives.

6- RESULTS

As mentioned before, one binomial test was used in order to study confirmation or rejection of each perspective or goal and Friedman test was used to rank perspectives and goals relative to each other.

A- Comparison of goals and measures

In order to compare goals and measures which were designed on the basis of the balanced scorecard of enterprise architecture, the Wilcoxon test was used. With regard to the test statistics, value $Z = -6.847$ was obtained with p-value 0.0005 indicating a significant difference between the goals and measures. On this basis, 62 measures were compared with their related goals. Among the 62 measures identified in 41 determined goals, the resulting rate was lower than their predicted rate in all measures. As mentioned above, experts' views and questionnaire were used regarding results of binomial test results in order to study authenticity of the proposed goals of enterprise architecture balanced score card and because p value significance level obtained for all perspectives was smaller than alpha's significance level (0.05), therefore, there is a significant difference between it and average value. Because the group results are more in groups higher than 3, it can be concluded that authorities and experts confirmed all goals but one of processes and applications perspective's. In all perspectives' goals, the number of people who gave responses more than average (represented by the number 3) was more than the number of people who selected responses smaller than or equal to the average number.

B- Perspectives and goals ranking results

On the basis of data obtained from test analysis, it can be observed that business perspective with mean rank of 2.58 is of the most importance and information and processes and applications perspectives with mean rank of 2.47 are of the least relative importance -which is not a significantly difference between them- as understood by experts of International institute of earthquake engineering and seismology.

It is necessary to note that the number of samples participating in this test was 49, Friedman Chi square statistic was 0.854 with freedom degree of 3 and Sig.= 0.836 which is higher than 0.05 and means lack of discrepancy. Figure 5 specifies the ranking of business, information, processes and applications, and technologic infrastructure perspectives' importance according to experts' judgments in International institute of earthquake engineering and seismology.

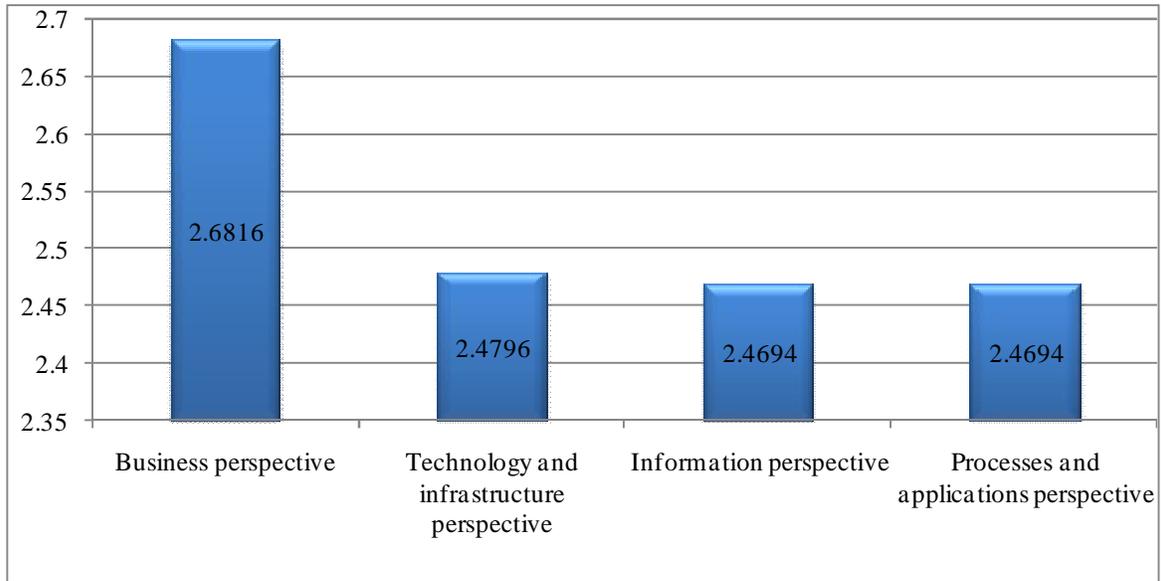


Figure 5: ranking of perspectives goals' importance

C- Results of measures comparison

Based on the data obtained from the aforementioned test's analysis, it can be observed that because P-value significance level obtained from measures regarding all perspectives is smaller than alpha significance level i.e. 0.05, therefore, there is significant difference between it and mean value and because group results are more in group smaller than or equal to 3, we can conclude that authorities and experts didn't find measures close to goals and considered the performed actions insufficient for achieving the related goals of the organization.

Table 2: Friedman ranking test table for perspectives measures

Measures	Mean rank
Business perspective	2.82
Information perspective	2.78
Technology and infrastructure perspective	2.46
Processes and applications perspective	1.95

With regard to the table above, relating to Freidman Ranking Test for business, information, processes and applications, and technological infrastructure perspectives, the highest rank relates to business perspective , the second rank relates to information perspective and the last rank relates to processes and applications perspective.

Table 3: measures ranking relative status study

Test Statistics ^a	
N	49
Chi-Square	31.658
df	3
Asymp. Sig.	.000

a. Friedman Test

On the basis of data obtained from the above test analysis, we can find that business perspective with mean rank value of 2.82 has the highest mark and processes and applications perspectives with mean rank value of 1.95 have the lowest mark according to experts of International institute of earthquake engineering and seismology. It is necessary to note that the number of sample participating in the test is 49 and Friedman Chi square statistic equals to 31.658 with freedom degree of 3.

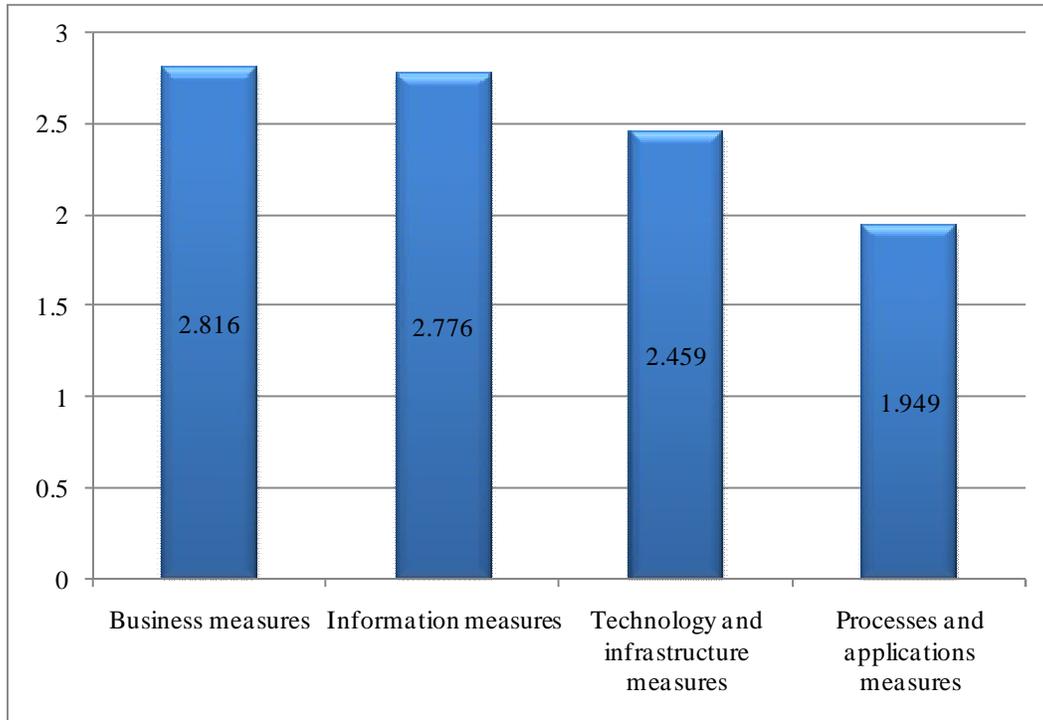


Figure 6: ranking and importance of perspectives measures

Here, we can note that the measures ranking does not conform to perspectives ranking and were observed with little displacement. In perspectives ranking, technological infrastructure perspective has the second rank after business perspective and experts believe that this perspective is more important than other perspectives in the research center and processes and applications perspective's being in the last place indicates the nature of the institute and there is small difference in ranking of perspectives and measures so that the technological infrastructure perspective has the second rank with little difference. In measures, this second rank relates to information perspective after business perspectives indicating weaker performance of technological infrastructure measure than that of information perspective which should be considered by the authorities, managers, and planners.

7- Conclusion

In this research, role of enterprise performance evaluation was studied with use of balanced score card method mentioned and while translating the strategy, organization's prospects and mission, the goals and measures in four perspectives of business technological infrastructure, information, and processes and applications were extracted and results of questionnaire confirm the goals optimally and this indicates conformity between the enterprise strategy and the mentioned goals. But according to the results obtained from measures, we can mention that because P-value's significance level obtained from measures for all perspectives is lower than alpha's, therefore, there is significance difference between it and mean value and because groups results are more in the smaller than or equal to 3 group, we can conclude that authorities and experts didn't find measures close to the goals and they considered the performed actions insufficient for achieving the enterprise goals. Respondents' awareness, senior managers of the organization's appreciation of such awareness, prioritization of goals and measures of targets evaluation, which shows the distance to the desired status of the organization, are among the results of this research. Not only achievements of this research give solutions for achieving predetermined strategic goals, but also use of this method for evaluating enterprise architecture leads to flexibility of the systems against changes and increased speed of changes in order to prevent loss of capital and time due to unsuitable enterprise architecture planning.

One of the developmental methods which are available in the method and should be dealt with in the future is the honesty of the respondents for telling truth and giving correct points to the measures. In addition,

study of the results obtained from evaluation of public and private organizations and research and non-research organizations can be regarded as guidance for future research subjects.

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