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# Evaluation of the Performance of Production Units Using the Combined Model of BSC and ARGUS

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## ABSTRACT

Nowadays, in the competitive world, to know the current situation of the system and to identify their own strengths and weaknesses companies and organizations require appropriate performance evaluation methods that consider all aspects and evaluate the individual, unit or organization and provide the necessary feedbacks. Balanced Scorecard enables the managers to have a comprehensive framework in order to convert the strategic objectives of the company to a series of related performance measurement criteria. This means that successful companies do not merely rely on financial measures to evaluate their performance, but also evaluate their performance from three other perspectives, that is, customer, internal processes, and learning and growth. In this study, after the literature review and using the Balanced Scorecard method which is a comprehensive model for evaluation, it has been tried to develop, in four dimensions of this method, the criteria related to the production units of medical equipment manufacturing of Ata teb Novin Company and to qualitatively evaluate the performance of the units. In addition, using ARGUS technique, which is a qualitative technique, ranks the units. Finally, using the acquired results, besides developing a model for continual evaluation in the organization, it has offered the practical suggestions with respect to the ranking provided for the studied organization.

**KEYWORDS**: performance evaluation, balanced scorecard, ARGUS technique

## 1. INTRODUCTION

Every organization, whether for-profit and non-profit, is formed to achieve some goals that are determined by the beneficiaries. On the other hand, achieving superior performance and gain the desired results without a program within the frameworks of an integrated and codified system would not be possible. The system should be able to plan the performance and codify and implement the programs through executive systems and using evaluation systems improve the performance. Emphasis on evaluation and performance assessment can be seen since the distant past and the formation of the first human societies [1].

British physicist Lord Kelvin said so about the necessity of measurement: "whenever we were able to measure what we talk about and expressed it in terms of numbers and figures, we can claim that we know something about the subject being talked about. Otherwise, our knowledge and awareness is imperfect and will never reach the stage of maturity. "The science of management also confirms the above content. Moreover, experts and scholars believe that the performance assessment is the main issue in all organizational analyses, and organizational thinking that do not include evaluation and performance measurement is difficult [2].

Main objective of this paper is to develop a BSC-ARGUS approach for evaluating the performance of operating units. This paper uses this approach to evaluate the organizational units in the form of a case study. For the purpose of the research, literature review, balanced scorecard and ARGUS technique are described and then research methods, findings and conclusions will be put forward.

## 2. REVIEW OF LITERATURE

First, the literature on performance evaluation by combining BSC and MCDM techniques are discussed: Jafari Eskandari et.al, in a study entitled "Evaluation of the Iranian industrial business environment in support of the private sector with Balanced Scorecard (BSC) approach", used a combination approach of Fuzzy Analytic Hierarchy Process and Balanced Scorecard to evaluate the industrial business environment in Iran [3].

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Lee et al. used an integrative approach of Fuzzy Analytic Hierarchy Process and Balanced Scorecard to evaluate information technology unit in a manufacturing industry in Taiwan [15].

In an article by Richards, the BSC has been used to select indicators and then the DEA are used to determine the standards and to compare the evaluated unites [16].

Moreover, Jui Chi Woung and Hasing Wu Calj have conducted a study to evaluate the efficacy of Acer corporate performance using data envelopment analysis and balanced scorecard [17].

Alirezaei, Mir Hassani, Husseini and Keshvari have provided an article entitled "comprehensive system of efficiency of organizations using DEA and focusing BSC" at the National Oil Company and in the process of drilling oil wells [5].

Mehrgan et al article titled BSC-TOPSIS integrated approach to assess Tehran's superior management schools that taking into account the strengths of the balanced scorecard in evaluating performance has combined it with TOPSIS technique to rank a number of superior management schools [8].

With respect to investigations in the field of performance evaluation and their use of the balanced scorecard approach and a variety of MCDM techniques, this study used ARGUS technique to rank organizational units with the criteria set out in the BSC field.

## 3. Balanced Scorecard

Measuring performance is of the best ways to get information for decision-making in organization .Between 1850 and 1975 organizations could only decide on the basis of the financial size institutions to ensure their success. However, with increased competition in the markets, managers need to be aware of other aspects of organization performance in addition to financial measures [6].

Organization, individuals or organizational unit, although apparently performing work, are only considered parts of the system and situation of other components should also be considered. Paying attention to comprehensive criteria and strategies and goals of the organization, are tools for a comprehensive performance management system. This approach to performance evaluation is a realistic, justice-oriented, trustworthy and reliable, promoter and dynamic assessment [4].

One of the most successful tools in the implementation of organization's strategic programs for achieving a new performance measurement system is the Balanced Scorecard [10].

Balanced Scorecard was introduced by Robert Kaplan, a Harvard University professor, and David Norton, a prominent management consultant, both of them from the Boston area. In 1990, Kaplan and Norton studied twelve reputable companies to find new ways for performance evaluation. The motivation for this study was a growing belief that the financial measures of performance do not have sufficient efficacy for modern business organizations. Companies being studied along with Kaplan and Norton were convinced that relying on financial measures has affected their ability to create value. The study team examined and discussed several possible options but agreed on the idea of a balanced assessment. The characteristic of it was the performance measures covering the entire organization. Kaplan and Norton's called the new tool the Balanced Scorecard. Later they summarized this concept in their first of three articles published in a research Journal at Harvard University entitled "The Balanced Scorecard, measures that drive performance" [12].

## 4. Balanced Scorecard Perspective

### 4.1. Customer perspective

According to this view, managers should translate into specific parameters the public statement of their mission with regard to the customer. That is really relevant to the customers; for example, the index of customer satisfaction and the number of complaints made by the customers. When selecting measures for the customer perspective in the balanced assessment model, organizations must answer two critical questions: Who are the target customers? What is our proposed value in serving them? [12].

### 4.2. internal processes perspective

According to this view, organizations should determine that on what processes and competences they are perfect so that they can continue their value creation for their customers and shareholders and each of their indices for measurement should be determined in the way that based on it the management should be able to judge easily that there is a connection between internal processes and competences and rate of operational significance that staff do for providing overall business goals [9].

### 4.3. Learning and growth perspective

In fact, the purpose of this perspective is to provide the infrastructure and resources that make it possible to attain the other objectives of the organization. In other words, the managers determine where the position of the

organization is and where they need to be in order to be successful in the future? This aspect specified the way of achieving that position.

In the near future, only organization that are able to utilize the skills, commitment and learning capacity of the individuals in all levels of the organization in the best way possible can claim to be superior [14].

### 4.4. The financial perspective

We can put all our efforts to improve customer satisfaction, improving the quality and reducing the time to deliver our products and services. However, if these measures do not lead to tangible results in financial reporting, they would not worth much [7].

## 5. ARGUS Technique

ARGUS technique is one of the qualitative method MCDM (Multi-Criteria Decision Making). This method is one of the compensatory model techniques. The following points are about this technique:

1) This technique is based on qualitative criteria to be evaluated, because the human mind can understand qualitative issues better the quantitative ones.

2) The technique relies heavily on decision-maker and in most steps it is the decision-maker who determines the qualitative criteria.

3) This technique uses Out Ranking to categorize the options [18].

The method's steps and the process of development of the technique are as follows:

First, we have a table of options and criteria that it used for the ranking.

First step: We have a pair wise comparison of values in each index which are done separately. So we will have as many tables as the number of indicators. And these tables are of two different types based on the indicators which are of a sequential index type and the ratio index type.

To determine the qualitative value of comparisons in this step, five cases of preference has been considered.

1. Indifferent preference
2. Slight preference
3. Moderate preference
4. Strong preference
5. Very high preference

To write tables of indicators, in this step, values should be written down from the best to the worst respectively and then they should be compared.

The second step: Important indicators should be chosen by the decision maker among the five following weights:

1. Not important
2. Slight importance
3. Moderate
4. Very important
5. Extremely Important

The third step: Importance of indicators with the preferred structure are combined in Table 1 (a defined ranking from the best R1 to the worst R8)

Table 1. The composition of the preferred structure and importance of criteria

| ***Importance preference*** | **Not important** | **Slight importance** | **Moderate** | **Very important** | **Extremely Important** |
|---|---|---|---|---|---|
| Slight preference | R8 | R7 | R6 | R5 | R4 |
| Moderate preference | R7 | R6 | R5 | R4 | R3 |
| Strong preference | R6 | R5 | R4 | R3 | R2 |
| Very high preference | R5 | R4 | R3 | R2 | R1 |

The fourth step: A paired comparison is conducted on the options. In addition, there will be a table for each comparison. First, we identify the degree of importance of the first indicator and then in the row of the first indicator in the primary table, first and second options are compared and the difference between the two are determined to know in which preferred mode they fall.

The fifth step: In this step in accordance with each table of comparison of options, we determine the ranking of comparisons. (From R1 to R8) and based on the tables we draw in this step, considering the following six modes, we will have four relationships between the options:

$\sum g=\sum h \Longrightarrow x_i$ indifferent $x_j \Longrightarrow$ ( *the two options are indifferent*) 1

$\sum g>\sum h \, , \sum h = 0 \Longrightarrow x_i \, S \, x_j \Longrightarrow$ (*the first option dominates the second option*) 2

$\sum g \geq \sum h \Longrightarrow x_i \, S \, x_j \Longrightarrow$ (*the first option has primacy over the second option*) 3

$\sum g<\sum h \, , \sum g = 0 \Longrightarrow x_j \, S \, x_i \Longrightarrow$ ( *the second option dominates the first option )* 4

$\sum g \leq \sum h \Longrightarrow x_j \, S \, x_i \Longrightarrow$ ( *the second option has primacy over the first option )* 5

*for other options* $\Longrightarrow x_i \, R \, x_j \Longrightarrow$ ( *the two options are incomparable*) 6

With regard to the six modes and tables of the fifth step the relationships among the options should be determined.

Sixth step: In the last step, in accordance with the table of relationships, the graph of relationships of options should be drawn. (Only the primacy and dominance relationships should be indicated in the graph)

Each option with more outward arrows is put in the first level and will be removed from the graph and so the options are ranked in this way [18][13][11].

## 6. RESEARCH METHODOLOGY

The performance assessment framework presented in this study is used by Ata teb Novin Company, which is active in the field of production of medical equipment.

After reviewing previous studies and surveying the experts, balanced scorecard indicators for the company were identified and verified.

In doing so, a questionnaire including selected criteria of literature review were distributed among desired experts (six senior managers) and they were asked to determine the degree of relevance of the proposed measures with evaluation of the performance of the company based on the spectrum provided. In the end, the criteria associated with the studied units of the company were determined in Table 2:

Table 2. The studied criteria in BSC perspectives

| criteria | Dimensions BSC | criteria | Dimensions BSC |
|---|---|---|---|
| Employee satisfaction | Growth and learning | The rate of waste | **Internal processes** |
| Development of employees skills | | Output ration to people / hour | |
| The number of studies on competitors | | Production cycle times | |
| Succession planning | | Improvement of production process | |
| Customer satisfaction | customer | Innovation in product design | |
| Attracting new customers | | Cost control | **financial** |
| Product quality | | Net profit rate | |
| Keeping customers | | | |
| Earnings per customer | | Advertising Costs | |
| Reputation and image | | | |

To assess performance of the units on the basis of the criteria of each dimension of BSC a questionnaire was designed and distributed among relevant experts.

After considering the relationship between the dimension and the criteria determined by BSC in the context of experts activities different number of questionnaires was filled by the experts.

So that, evaluating the performance of production units in the customer's dimension criteria was examined by seven experts, financial dimension criteria examined by four expert, internal processes dimension criteria examined by nine experts, learning and growth dimension criteria examined by nine experts.

To evaluate the performance of production units in the overall dimensions of the BSC, as well as to determine the importance and weight of the criteria, related questionnaires were distributed among the six experts of the company who were more qualified.

To apply ARGUS method, first of all the decision-making matrices of different experts must be combined through the mean, and then considering the final saying of the company's managing director the verbal scale for each criterions is specified and the overall dimensions of BSC are determined. The final matrix of the main dimensions of the BSC is shown in Table 3:

Table 3. Final matrix of integration of experts' opinion on the overall dimensions of BSC

| criterion / option | customer | Internal process | financial | learning |
|---|---|---|---|---|
| A1 | Relatively high | medium | Relatively high | **medium** |
| A2 | Relatively high | medium | Relatively high | **medium** |
| A3 | medium | medium | medium | **medium** |
| A4 | medium | medium | Relatively low | **medium** |
| A5 | medium | Relatively high | Relatively low | **Relatively high** |

After that, according to Table 4, the importance of their size and weight are determined:

Table 4. The matrix for determining the importance of dimensions

| weight | Indicator (dimensions) |
|---|---|
| Not important | |
| Slight importance | |
| Moderate | |
| Very important | **Growth and learning- financial-internal processes** |
| Extremely Important | **customer** |

After going through the steps of ARGUS method, the relationship between the units is shown in Table 5, and as the results the overall graph of ARGUS in the overall dimension of BSC is shown in Figure 1.

Table 5. The relationships between options (production units)

| Types of relations | Result of comparison of options |
|---|---|
| incomparable | **$A_1RA_5$ , $A_2RA_5$** |
| indifference | **$A_1IA_2$** |
| primacy | **$A_5SA_3$** |
| dominance | **$A_1SA_3$ , $A_1SA_4$ , $A_2SA_3$ , $A_2SA_4$ , $A_3SA_4$ , $A_5SA_4$** |

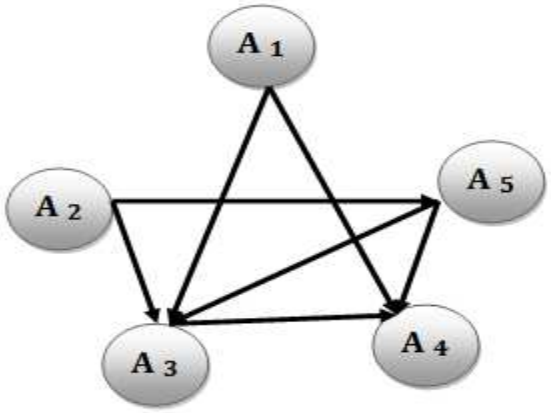


**Fig.1.** Graph of the relationship among the option in the overall dimensions of BSC

### 7. Research Findings

Final ranking of the studied units in the dimensions of BSC is shown in Table 6:

Table 6. Ranking of units based on BSC four dimensions

| All four dimensions(overall dimension) | Financial dimension | Customer dimension | Internal processes dimension | Growth and learning dimension | Production unit |
|---|---|---|---|---|---|
| 1 | 3 | 1 | 2 | 1 | $A_1$ |
| 1 | 1 | 1 | 2 | 2 | $A_2$ |
| 3 | 3 | 3 | 2 | 3 | $A_3$ |
| 4 | 3 | 4 | 2 | 4 | $A_4$ |
| 2 | 2 | 2 | 1 | 5 | $A_5$ |

By paying attention to Table 6 it is determined that the first production unit in all dimensions has good condition, but according to the specified criteria, in the financial dimension has lower position than the other dimensions, but overall and due to the great importance of the customer dimension has achieved the first rank. The second production unit which overall has good condition in all four dimensions together with the first unit has achieved the first rank. The third production unit which except for the internal process in all dimensions had the third place in the overall ranking achieved the third rank. The fourth production unit has performed equally in the growth and learning dimensions and has ranked the fourth place, and in the financial and internal processes has acted better, but in general due to the importance of financial dimensions for the experts has ranked fourth. And fifth production unit has good condition in financial, customer and internal processes dimensions , but has an unsuitable place in grow and learning dimension and overall has achieved second rank.

## 8. CONCLUSIONS AND RECOMMENDATIONS

In this study, the performance of production units of a manufacturing company has been evaluated using BSC-ARGUS combination method. This study extends the literature on the subject due to the fact that it's the first time this model had been studied in Iran. In fact the new achieved aggregation model have had a new look to performance evaluation. Due to the growing trend of using the balanced scorecard for evaluating performance, first the indicators of evaluation of units were designed by this technique and were measured qualitatively. And then using the ARGUS technique, all of its stages being qualitative, five units of manufacturing company were assessed and ranked.

This study has used the combination of BSC-ARGUS methods, but the combination of BSC method with other techniques of MCDM can be used too.

### 9. The practical suggestions

Using the presented ranking, company managers can make better decisions in the strategic issues of the company, especially in directing sales prediction. That means the production unit that in most dimensions, especially customer and financial dimensions that is more important for the experts, is ranked the lowest, should change its production methods, marketing and etc, Otherwise this unit could be integrated with the units with higher ranking which the market have the capacity to sell, and the company has the ability to produce.

Based on the conducted ratings, average scores, and each unit level in each criterion, company officials can try to improve it and take any necessary action to hold the high ranks in the investigated dimensions and to strengthen the lower ranks.

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