

## On The Investigation of Performance Compliance with the Balanced Scorecard (BSC) Model In Three Pharmaceutical Companies

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**Abstract:** *In the last two decades, organizational performance management has turned into one of the most significant and interesting topics, and such a trend has led to the development of many innovations in both areas of research and application. Performance evaluation is one of the vast areas on which a wide range of disciplines and many experts have exerted great influence and a number of new reports and articles have been written. Furthermore, there has been a major growth in the number of practical software's developed in this area. However, despite plenty of models and frameworks in the field of some conceptual models, researchers have the greatest effect on shaping this unique field. The balanced scorecard (BSC) has gone under great development and evolution over time and now has turned into a common tool for assessing and measuring performance, and a strategic management system. Therefore, in this study, the combination of this model and multi-criteria decision-making methods are used in order to achieve more desirable results. The outcome of this research is ranking the three companies under study based on the aforementioned techniques within the time span specified in the study.*

**Keywords:** *Performance evaluation, balanced scorecard, multi-criteria decision-making methods, TOPSIS model*

### 1. Introduction

Each organization is in urgent need of a performance evaluation system in order to determine the degree of desirability and quality of its activities, especially in complex and dynamic environments. On the other hand, lack of the evaluation and control system in an organization means that there is no interaction with the environment inside and outside the organization. This is the consequence of aging and death. The consequences are organizational aging and death. It is also possible that organization managers do not feel the organizational death due to its gradual occurrence. However, research shows that lack of feedback for possible revisions makes it impossible for organization activities to grow, develop

and improve. The eventual result of this is organizational death.

In the past, trade organizations employed traditional performance evaluation systems which were only based on financial indices. These systems' shortcomings led researchers and users move towards the new performance evaluation system. Kaplan and Norton were among the researchers who discussed the management accounting systems and performance evaluation. Analyzing various functional aspects of organizations and identifying inefficiencies of the traditional systems, they presented a new model for organizational performance evaluation called the Balanced Scorecard (BSC).

Balanced Scorecard created a common language for managers to discuss the direction and priorities of their organizations. This model has four dimensions and the goals and performance indices are not independent in these dimensions and there is a causal relationships between them. Development

## 2. Objectives and research questions

The objectives of this research are as follows:

- Ranking under study companies
- Formulation of indices and factors for measuring the performance of the companies
- Creating a framework for describing the financial aspects of the organization's strategy, customers, internal processes, and learning and growth
- Providing solutions to improve the financial aspects, internal processes, learning and growth, and customers

The questions to be answered in this study are as follows:

1. How to evaluate a company's performance using the BSC and multi-criteria decision methods?
2. What are the selected indices for evaluating companies from financial, customer, internal process, and learning and growth perspectives?
3. Based on the balanced scorecard indices, how was the performance of Alborz Darou pharmaceutical, Sobhan Darou pharmaceutical, and Iran Darou pharmaceutical, Companies over a three-year period ending in 2012?
4. How was the overall ranking of these companies over these three years?

## 3. Review of the literature

### 3.1. Performance evaluation:

Performance evaluation is a process to measure, evaluate, and judge performance over a specific period [6].

Performance evaluation is measuring performance through comparing the

and implementation of this model requires a lot of effort and dedication, but the result will be identifying the key factors which make the organization's strategies implemented and accessible in the form of four fundamental aspects and in a clear causal relationships.

current situation with the desired or ideal situation according to predetermined criteria which meet certain characteristics. [7]

Totally, system performance evaluation can be considered as the process of evaluating, measuring, and comparing how to achieve the desired status with the specified criteria in the attitude and the area covered by given indices and over a period specified for the purpose of continuous review, revision, and improvement. [8]

### 3.2. Balanced Scorecard model

Balanced Scorecard model emphasize on three dimensions (namely past, present, and future) for assessments since the past performance may lead to a result in today or tomorrow and today performance resulting in tomorrow one.

In this model, the indices are 2 groups: Drivers Performance and Measures Outcomes. This model seeks to connect organizational strategies to organizational operations through determining the critical success factors and strategic factors.

Financial perspective  
Internal Process perspective  
Customer Perspective  
Learning and Growth Perspective

The selected criteria for the BSC should be linked in a chain of causal relationships to be able to describe business strategies. The chain begins from the growth and learning perspective and end in a desired performance for financial respective. You claim that customer loyalty leads to more income, so it is considered as a benchmark in customer perspective but how can we create customer loyalty? Which internal processes should be performed to be led to

customer loyalty and ultimately more income? One possible answer is your ability to provide continuous innovation and new products to the market. Therefore, you decide to measure the product development cycle. You ultimately must decide how to improve the cycle time of the production process. Investing on staff training to enhance their creativity may reduce new product cycle time. As a result, it measures it in the growth and learning dimension. [7, 5 and 8]

#### 4. Research Methodology

The aim of the present study is functional and data collection is descriptive. This study is a case study with the following implementation phases:

##### Phase I- Library studies

In this phase, we studied available resources including published books, theses, and articles and checked internet websites related to the topic discussed in order to get familiar with the literature of theoretical research.

##### Phase II - Recognizing companies

At this stage, an exact knowledge of the Alborz Darou pharmaceutical, Sobhan

Darou pharmaceutical, and Iran Darou pharmaceutical companies was acquired. This knowledge includes: A recognition of domains, tasks, and activities of the company, customers, stakeholders, organizational structure, perspectives, and missions. This recognition is done by examining documents.

##### Phase III - Determination of performance evaluation indices based on selected models and appropriate for research companies

The most important performance evaluation indices which help them to achieve the vision and mission accomplishment were extracted based on the BSC defined financial, customer, internal processes and learning, and growth perspectives through interviews with experts and managers, and books and articles. After reviewing the literature and studying the companies' visions and missions, the main assessment indices for the four perspectives of the balanced scorecard were extracted and delivered to experts in order to provide their comments and suggestions. After collecting the information, opinions, and resources, 18 indices were determined as the main indices of BSC. The main indices are presented in the following tables [1, 2, 3, and 4].

**Table 1: Assessment indices**

| Row | Aspect                   | Index                 | Sub-indices                            |
|-----|--------------------------|-----------------------|--|
| 1   | Development and learning | Staff Skills          | Number of training courses             |
|     |                          |                       | Annual training hours                  |
|     |                          |                       | The mean duration of working           |
|     |                          |                       | Quality of education                   |
|     |                          |                       | Staff training costs                   |
| 2   |                          | Employee productivity | <i>sales/number of employees ratio</i> |
|     |                          |                       | <i>net income/manpower ratio</i>       |

| Row | Aspect           | Index                       | Sub-indices   |
|-----|------------------|-----------------------------|---|
|     |                  |                             | value added/number of employees ratio   |
| 3   |                  | Employee satisfaction       | Salaries paid to employees per year<br>Benefits paid to employees per year<br>Remuneration paid to employees per year<br><i>Average hours of absence of staff per year</i>  |
| 4   |                  | Information infrastructures | Software infrastructures<br>Hardware infrastructures<br>Internet and websites<br>Information technology costs   |
| 5   |                  | Motivation and co direction | Number of proposed suggestions by employees/total number of employees ratio<br>Number of implemented suggestions/total number of employees ratio  |
| 6   | Internal process | Innovation                  | Sales obtained from new products<br>R & D expenses/sales ratio<br>Number of market survey research<br>Percentage of sales from products the technology of which is exclusively available to the company<br>Time required to develop a new generation of product<br>The number of times that the initial design of a product must be modified so that it can be supplied into the market |
| 7   |                  | Supply                      | The number of foreign suppliers<br>The number of local suppliers<br>Average speed of procurement of materials and goods within the country<br>Average speed of procurement of materials and goods from outside the country<br>Foreign purchases of materials and goods/total purchase of goods ratio  |

| Row | Aspect                           | Index                              | Sub-indices  |
|-----|----------------------------------|------------------------------------|--|
|     |                                  |                                    | Net domestic purchase of materials and goods/total purchase of goods ratio |
| 8   |                                  | Production                         | Production cycle time  |
|     |                                  |                                    | The amount of waste  |
|     |                                  |                                    | Raw material inventory/sales ratio   |
|     |                                  |                                    | Goods in process inventory/sales ratio                                     |
|     |                                  |                                    | Finished goods inventory/sales ratio                                       |
|     |                                  |                                    | Actual production/production budget ratio                                  |
|     |                                  |                                    | <i>Stop period of Production Line in a year</i>                            |
|     |                                  |                                    | Percentage of compliance with the standards of                             |
|     |                                  |                                    | Number of times products are updated                                       |
|     |                                  |                                    | Production cost  |
| 9   |                                  | Distribution                       | Actual sales to sales budget   |
|     |                                  |                                    | Number of peer distribution companies                                      |
|     |                                  |                                    | Distribution and sales expenses/total sales ratio                          |
|     |                                  |                                    | The average time of delivery of goods to the customer                      |
|     |                                  |                                    | Advertising and marketing expenses/sales ratio                             |
| 10  | Customer                         | Market share                       | Sales to total industry sales  |
| 11  |                                  | Attracting customers               | Number of new customers/total customer ratio                               |
| 12  |                                  | Retaining customers                | Number of old customers/total customer ratio                               |
| 13  |                                  | After sales service                | The time taken to resolve customer problem                                 |
|     |                                  |                                    | Costs of after sales service/sales ratio                                   |
| 14  |                                  | Customer Satisfaction              | The number of complaints from customers                                    |
|     |                                  |                                    | Percentage of handling customer complaints                                 |
|     | Rail volume of returned products |                                    |  |
| 15  | Financial                        | Composition and growth of earnings | Rate of sales and revenues   |
|     |                                  |                                    | Growth rate of sales and revenues  |
|     |                                  |                                    | Profitability  |

| Row | Aspect | Index                    | Sub-indices   |
|-----|--------|--------------------------|---|
|     |        |                          | Growth rate of profitability                          |
| 16  |        | Reducing cost            | Cost of manufacturing products and providing services |
|     |        |                          | direct manufacturing labor costs/sales ratio          |
|     |        |                          | Material costs/sales ratio                            |
|     |        |                          | Overhead costs/sales ratio                            |
|     |        |                          | Discount costs/sales ratio                            |
|     |        |                          | Financial costs/sales ratio                           |
| 17  |        | Utilization of assets    | Applied investment/sales ratio                        |
|     |        |                          | Cash flow cycle                                       |
|     |        |                          | Rate of return on capital employed                    |
|     |        |                          | Rate of return on investment                          |
|     |        |                          | Net profit margin                                     |
|     |        |                          | Operating profit margin                               |
|     |        |                          | Circulation of assets                                 |
|     |        |                          | Return on assets                                      |
| 18  |        | Using financial leverage | Debt ratio  |
|     |        |                          | Debt-to-equity ratio                                  |
| 19  |        | Liquidity of assets      | Current ratio   |
|     |        |                          | Quick ratio   |

Furthermore, after revealing the main indices of the BSC four perspectives, subsidiary indices were extracted through library studies and reviewing the literature to assess the companies more accurately. Experts stated their opinions about them through interviews. Finally, after summarizing previous research studies, available resources, and expert opinions, subsidiary indices were specified for the evaluation of the companies. Table 1 presents the indices used.

#### **Phase IV- Collecting data on the specified performance evaluation criteria**

In this phase, we collected data on the BSC-based defined indices through analyzing organizational documents, running interviews, and extracting relevant data from the financial statements of these companies.

#### **Phase V - Explaining the results of the data analysis**

Using data obtained from the weighing matrix, decision matrix, and TOPSIS technique, these companies were ranked and the results obtained from the analysis of the data and rankings which reveal the performance of companies in different

areas were developed and approved by companies' managers and experts.

### 5. TOPSIS model

TOPSIS model was proposed by Huang and Yuns in 1981. It is one of the best MADM models and is used a lot. In this method,  $m$  options are assessed by  $n$  indices. This technique is based on the concept that the selected option should

have the least distance from the positive ideal solution (the best possible) and the maximum distance from the negative ideal solution (the worst-case). It is assumed that the utility of each index has been steadily increasing or decreasing. Multi-criteria decision making models including TOPSIS matrix are usually formulated by decision matrix where  $r_{ij}$  is  $i$ -th option value based on the  $j$ -th criterion.

| Options | Criteria |          |      |          |
|---------|----------|----------|------|----------|
|         | $x_1$    | $x_2$    | .... | $x_n$    |
| $A_1$   | $r_{11}$ | $r_{12}$ | .... | $r_{1n}$ |
| $A_2$   | $r_{21}$ | $r_{22}$ | .... | $r_{2n}$ |
| ...     | ...      | ...      | .... | ...      |
| $A_m$   | $r_{m1}$ | $r_{m2}$ | .... | $r_{mn}$ |

**Quantifying and de-scaling a decision matrix (N):** In this study, we used normal linear normalization for normalizing. To do so, the value of each index column is divided to the maximum value of that index column for positive indices and for negative indices, the lowest value in the index column is divided to each column index values.

**Determining the indices weights:** the indices weights are calculated using weighted least squares. The output will be the weight vector  $W$ :

$$W = \{W_1, W_2, \dots, W_n\}$$

**Determining de-scaled weighted matrix (V):** the de-scaled matrix (N) is multiplied by the diagonal matrix of weights ( $W_n \times n$ ):

$$V = N \times W_n \times n$$

Determining the positive and negative ideal solutions is as follows:

The vector of the best values for each matrix index= positive ideal solution (+V)

The vector of the worst values for each matrix index= negative ideal solution (-V)

The best value for positive indices is the largest one and for the negative indices is the smallest one. The worst values for the positive indices are the smallest values and for the negative indices are the smallest values.

**Determining the distance of each option from the positive and negative ideals:** Euclidean distance of each option from the positive ideal is ( $d_j^+$ ) and from the negative ideal dis ( $d_j^-$ ). They are calculated based on the following formula:

The distance of *i*  
 – th option from a positive ideal

$$= d_i^+ = \left\{ \sum_{j=1}^n (V_{ij} - V_j^+)^2 \right\}^{0.5} ; i$$

= 1,2, ..., m

The distance of *i*  
 – th option from a negative ideal

$$= d_i^- = \left\{ \sum_{j=1}^n (V_{ij} - V_j^-)^2 \right\}^{0.5} ; i$$

= 1,2, ..., m

**Determining the proximity (CL +) of an option to the ideal solution:**

$$cl_i^+ = \frac{d_i^-}{(d_i^+ + d_i^-)} ; 0 \leq cl_i^+ \leq 1 ; i$$

= 1,2, ..., m

**Ranking Options:** Any option which has a bigger CL is better. [6 and 9]

**6. Data analysis**

The purpose of this section is to evaluate Sobhan Darou pharmaceutical, Alborz Darou pharmaceutical, and Iran Darou pharmaceutical, companies over the period of 2009-2011. In this regard, we ranked companies using the Balanced Scorecard model based on TOPSIS technique through evaluating and analyzing the companies' data.

1) During-ranking processes using TOPSIS

**The first stage: Collecting and summarizing the data for each perspective of the model**  
 The Companies three years data were collected and placed in the matrices designated to gather this information.

**The second stage: De-scaling data and having access to decision matrix:**

Decision matrix should be normalized so that its elements will be descaled. The linear normalization was used for normalizing in this method. In this order, the value of each index column is divided to the maximum value of that index column for positive indices and the lowest value in the index column is divided to each column index values. The following tables present the companies' de-scaled score matrix in the four dimensions of the balanced scorecard:

**Table 2: De-scaled Matrix**

| De-scaled score Matrix in the four dimensions of the BSC model |      |      |      |      |
|--|------|------|------|------|
| Alborz Darou pharmaceutical company                            | 0.20 | 0.21 | 0.23 | 0.23 |
| Iran Darou pharmaceutical company                              | 0.17 | 0.19 | 0.21 | 0.16 |
| sobhan Darou pharmaceutical company                            | 0.24 | 0.22 | 0.23 | 0.25 |

**The third stage: calculating the weights of the model four dimensions**

Shannon entropy is used to calculate the weights. In summary, the following steps can be used to obtain the indices weights:

$$W_j = \frac{d_j}{\sum_{j=1}^n d_j}; \forall_j$$

Step 1 – Calculate  $p_{ij}$

$$p_{ij} = \frac{a_{ij}}{\sum_{i=1}^m a_{ij}}; \forall_j$$

Step 5. Calculating the adjusted weights  $W_j$

$$W_j = \frac{\lambda_j w_j}{\sum_{j=1}^n \lambda_j w_j}; \forall_j$$

Step 2: Calculating the amount of entropy

$$E_j = -k \sum_{i=1}^k [p_{ij} \ln p_{ij}]; \forall_j$$

$\lambda_j$  are subjective (judgmental) weights (Note: If the subjective (judgment) weights are not available, it is impossible to have Step 5.) The positive or negative values of the indices would have no effect on weight calculation method in the entropy model. The weight of each four dimensions of the Balanced Scorecard has been calculated using the aforementioned technique:

Step 3 - Calculating the amount of uncertainty

$$d_j = 1 - E_j; \forall_j$$

Step 4 – Calculating the weights  $W_j$

**Table 3: The indices weights**

| Learning and growth | Process Internal | Customer | Financial |
|---------------------|------------------|----------|-----------|
| 0.15                | 0.06             | 0.32     | 0.47      |

**The fourth stage: Creating a normalized weighted matrix**

Normalized weighted matrix= indices weights × normalized matrix

This matrix can be obtained using the following formula:

**Table 4: De-scaled weighted Matrices**

| Description                         | Learning and growth | Internal Process | Customer | Financial |
|-------------------------------------|---------------------|------------------|----------|-----------|
| Alborz Darou pharmaceutical company | 0.090105            | 0.044675         | 0.174249 | 0.272394  |
| Iran Darou pharmaceutical           | 0.062886            | 0.040092         | 0.154602 | 0.228095  |

|                                     |          |          |          |          |
|-------------------------------------|----------|----------|----------|----------|
| company                             |          |          |          |          |
| Sobhan Darou pharmaceutical company | 0.095909 | 0.044997 | 0.183222 | 0.316304 |

**The fifth stage: Determining the positive and negative ideal solutions**

To obtain the positive ideals: Find the largest element in the positive columns

and the smallest element in the negative columns.

To obtain the negative ideals: Find the smallest element in the positive columns and the largest element in the negative columns.

**Table 5: Determining the positive and negative ideals**

| Description    | Learning and growth | Internal Process | Customer | Financial |
|----------------|---------------------|------------------|----------|-----------|
| Ideal Positive | 0.1                 | 0.04             | 0.18     | 0.32      |
| Negative ideal | 0.04                | 0.02             | 0.14     | 0.21      |

**The sixth stage: Calculating the distance from the positive and negative ideals**

The distance of  $i$   
 – th option from a positive ideal

$$= d_i^+ = \left\{ \sum_{j=1}^n (V_{ij} - V_j^+)^2 \right\}^{0.5} ; i = 1, 2, \dots, m$$

The distance of  $i$   
 – th option from a negative ideal

$$= d_i^- = \left\{ \sum_{j=1}^n (V_{ij} - V_j^-)^2 \right\}^{0.5} ; i = 1, 2, \dots, m$$

**Table 6: The distance from the ideals**

| The company                         | The distance from the positive ideal | from the negative The distance ideal |
|-------------------------------------|--------------------------------------|--------------------------------------|
| Alborz Darou pharmaceutical Company | 0.046                                | 0.09                                 |
| Darou pharmaceutical Iran Company   | 0.099                                | 0.04                                 |
| Sobhan Darou pharmaceutical Company | 0.002                                | 0.13                                 |

**The seventh stage: Rating the options through calculating the options' relative proximity to the ideal solution (CL)**

$$cl_i^+ = \frac{d_i^-}{(d_i^+ + d_i^-)} ; 0 \leq cl_i^+ \leq 1 ; i = 1, 2, \dots, m$$

Each option with a bigger CL is better.

**Table 7: The companies' relative proximity and ranking**

| The company                         | Relative proximity to ideal solution |
|-------------------------------------|--------------------------------------|
| Sobhan Darou pharmaceutical Company | .98                                  |
| Alborz Darou pharmaceutical Company | .66                                  |
| Iran Darou pharmaceutical Company   | .27                                  |

## 7. Results

The results can be divided into several categories with respect to the objectives and research questions:

Here are described the ranking results based on the BSC four perspectives over the period of 2009-2011 using average data in TOPSIS method.

The last stage of the TOPSIS method is calculating the options' relative proximity to the ideal solution. In this regard, each company which has the highest relative

proximity to the negative ideal solution and the lowest relative proximity to the positive ideal solution has a higher proximity index. As a result, it will be ranked in a higher position based on the four BSC weighted perspectives in the TOPSIS technique. Their rankings are observable in the above table. As it can be seen:

Based on the BSC weighted perspectives and identified indices in each perspective, the companies are ranked according to their performance and their relative priorities to other companies. Sobhan Darou pharmaceutical company, Alborz Darou pharmaceutical company, and Iran

Darou pharmaceutical company are ranked in the first place to third, respectively.

The companies' performances can be analyzed to verify the authenticity of these ratings in the BSC four dimensions. One of the key concepts in the companies' performance is the presence of cause and effect relationships between different functional areas of a company. This key concept which and also be explained by the concept of compensatory feedback and cybernetics and system dynamics, has been taken into account in the BSC model. The companies' performance in two areas of financial and market dimensions has a delayed aspect and is dependent upon the company performance in two areas of internal processes and learning and growth. In fact, it is the performance in these two areas which leads the company's performance in financial and market areas. It also should be noted that the company's performance has not occurred in a vacuum and is strongly influenced by the environment or the prevailing business situation.

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