International Scholars Journals

Global Journal of Business Management ISSN 2736-1721 Vol. 14 (3), pp. 001-006, March, 2020. Available online at www.internationalscholarsjournals.org © International Scholars Journals



*Full Length Research Paper*

# The best selection of strategic plans in balanced scorecard using multi-objective decision making model

**Javad Dodangeh[1]*, Rosnah Bt Mohd Yusuff [1] and Javad Jassbi[2]**

[1]Department of Mechanical and Manufacturing Engineering, University Putra Malaysia Serdang, Selangor D. E., Malaysia.

[2]Department of Industrial Management, Islamic Azad University, Science and Research Branch, Tehran, Iran.

Accepted 13 December, 2019

**In an increasingly competitive business environment, many organizations have adopted the strategic planning approach in an attempt to achieve excellence in business. Implementation of appropriate strategies plays an important role for organizations' success. Balanced scorecard is an appropriate tool used for designing operational strategies. However, one of the balanced scorecard problems is its selection in strategic plans' performance. In this paper, a model was established for the selection of strategic plans in "balanced scorecard" using "goal programming model" which is one of the multi-objective decision making models. So, using the consensus of organizations' managers and experts' opinions, the measures and general objectives of the four perspectives are first determined in BSC, and then, using experts' opinions and taking the relative importance of decision makers' opinions into consideration, by using "goal programming model", the performances of strategic plans are selected in the BSC model. The results show that the introduced method is more reliable and acceptable and the experts verify the model for selecting strategic plans in the operation of BSC. The introduced method was used in a study and the extracted results from it were analyzed from different points of view. However, in this article, initiatives are called strategic plans.**

**Key words:** Balanced scorecard, initiatives, multi-objective decision making, goal programming.

## INTRODUCTION

Companies have always found it hard to balance pressing operational concerns with long-term strategic priorities. The tension is critical in that world-class processes will not lead to success without the right strategic direction, and the best strategy in the world will get anywhere without strong operations to execute it (Kaplan and Norton, 2008). Considering the importance of strategic planning in organizations and creating the competitive advantage in them have indeed, led the organization today to move to a competitive and complex environment where there is a transaction among them. The senior managers and all those seeking a compre-hensive picture of the present situation of the company, a clear understanding of the company's present situation and a clear understanding of its future image, need some information that are more than standards in financial operation to assess the strategic operation and long-term views of the company and also to achieve operational strategies.

Various kinds of tools are offered for this process, although 'balanced scorecard' is a suitable tool for evaluating and designing operational strategies. This tool, for the first time, was introduced by Kaplan and Norton in 1992 (Goodspeed, 2003; Kaplan and Norton 1996, 1992). BSC is a conceptual framework and its function is to translate the strategic objectives of a company into a set of operational attributes. These indices are usually selected from four perspectives: financial, customer, internal processes and learning and development (Kaplan and Norton, 1992; Najmi et al., 2001). Many attributes were used for the advancement of the company in the direction of its perspective. Some other attributes are used for evaluation of the company's development in accessing its long-term objectives. Furthermore, BSC helps the managers to identify the lagging and leading attributes in their company.

*Corresponding author. E-mail: jdodangeh@gmail.com.

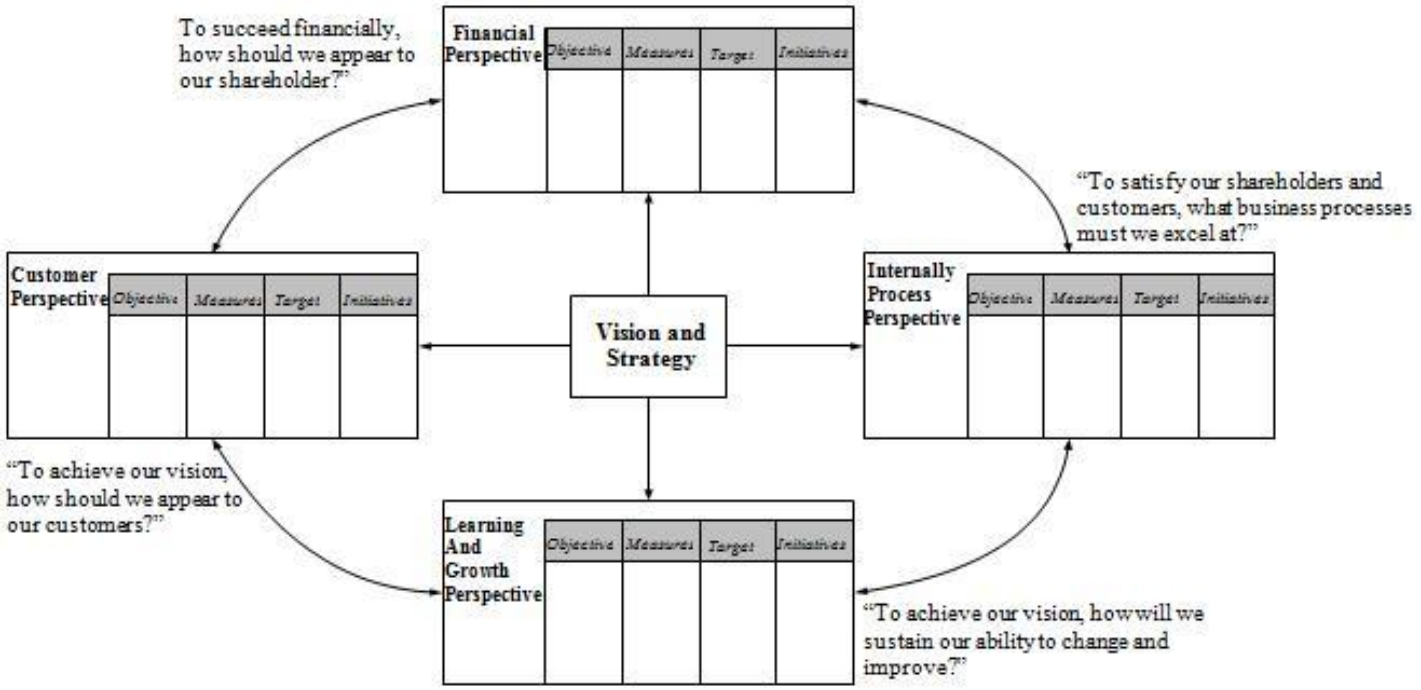


**Figure 1.** Balanced scorecard model (Kaplan and Norton, 1996).

The framework of balances evaluation model is shown in Figure 1 (Kaplan and Norton, 1992).

### Decision making methods

People generally use one of the two methods for making decisions:

1. Trial and error method.
2. Modeling method.

In the trial and error method, the decision maker faces reality, so he chooses one of the alternatives and witnesses the results. If decision errors are great and if they cause some problems, he changes the decision and selects other alternatives.

In the modeling method, the decision maker models the real problem and specifies elements and their effect on each other and gets through the model analysis and prediction of a real problem (Ghodsypour, 2003).

Multi-criteria decision making (MCDM) addresses decision making with regards to multiple and conflicting criteria. In fact, there are two types of criteria: objectives and attributes. Accordingly, MCDM problems can be broadly aligned into two categories:

1. Multi-objective decision making (MODM)
2. Multi-attribute decision making (MADM)

The main difference between MODM and MADM is that the former concentrates on continuous decision spaces, primarily on mathematical programming with several objective functions, while the latter focuses on problems with discrete decision spaces.

## MATERIALS AND METHODS

### Multi-objective decision making

Multi-objective decision making is known as the continuous type of MCDM. The main characteristics of MODM problems are that decision makers need to achieve multiple objectives, while these multiple objectives are non-commensurable and conflicting with each other. A MODM model considers a vector of decision variables as objective functions and constraints, whereas decision makers attempt to maximize (or minimize) the objective functions. Since this problem rarely has a unique solution, decision makers are expected to choose a solution from among the set of efficient solutions (as alternatives), which will be explained subsequently. Generally, the MODM problem can be formulated as follows:

$$Max: f(x)$$
$$s.t: x \quad X = \left[ x \quad R^n \middle| g(x) \le b, x \ge 0 \right]$$

Where f(x) represents n conflicting objective functions, $g(x) \le b$ represents m constraints and x is an n-vector of decision variables $x \quad R^n$.

### Goal programming

Goal programming was originally proposed by Charnes and Cooper (1961) and has been further developed by Lee (1972), Ignizio (1976, 1983) and Charnes and Cooper (1977). The method requests decision makers to set goals for each objective that they wish to

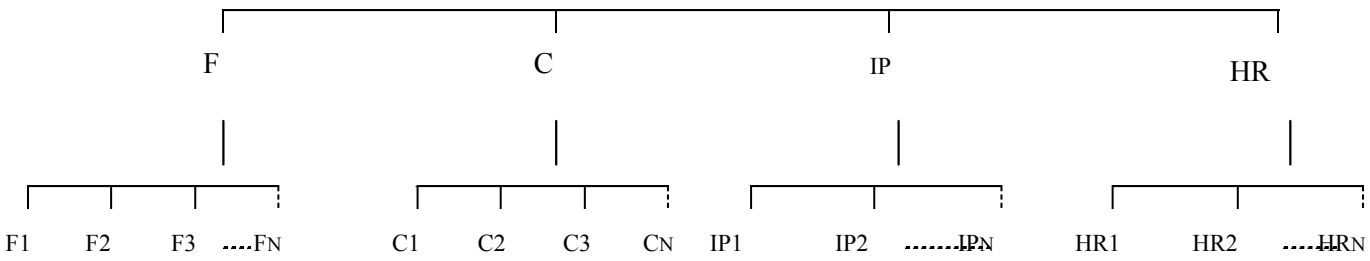


**Figure 2.** Set of hierarchical objectives.

wish to attain. A preferred solution is then defined as the one that minimizes the deviations from the goals (Zhang et al., 2007).

**Experts group and strategic plans weights**

Every MODM problem has some objectives that should be recognized by decision makers in due courses. All MODM methods require information that should be achieved based on the relative importance of the objective. Objective weights can be allocated to objectives directly by the decision makers' group or by scientific methods. These weights specify the relative importance of every objective. Usually, groups are classified based on their different levels in social status, knowledge and work experience. So every factor in a special subject that causes an increase or decrease of idea weight should be considered. In this regard, allocating different weight to people's opinions regarding their knowledge and experience in relation with that subject seems necessary. The study uses hierarchical objectives for determination of the strategic plans' weights as shown in Figure 2. For this process, the study determined the weights of perspectives and sub-perspectives using expert opinions. The final weights of the sub-perspectives (financial, customer, internal processes and learning and growth) were determined by using the geometric average method. The method for calculation is shown thus:

$$TW_{Cij} = W_{Ci} \sqrt{.W_{Cij}} \quad (1)$$

Where $TW_{Cij}$ = Final weights of objective, $W_{Ci}$ = Weights of perspective and $W_{Cij}$ = Weights of objective.

However, $TW$, which is the final weights of objective is equal to $Cij$ the strategic plan's weights (Dodangeh, 2006).

**The best selection algorithm of strategic plans in BSC**

In this method, decision makers (DM) set goals for each objective that they wish to achieve and determine the constraints for the model. A zero to one goal programming that is used to choose strategic plans is thus established.

Step 1: The study collected data and information containing general objectives, measures, quantitative targets and strategic plans in four perspectives and formed the framework of the BSC model.

Step 2: The study calculated the measures of aspect and general objectives in BSC using group decision making.

First, the study chose the members of the decision making group (the experts) who have been significant in the formation of strategic problems and initiatives, a nd then, the measures of the experts' viewpoint about the four perspectives of BSC were calculated. After that, the study calculated the measures of perspectives from the experts' view point. In some way, the measure of the general objectives in the four perspectives of BSC can be calculated thus:

Step 3: The final measure of the general objective using the geometrical average should be calculated.

Step 4: Finally, strategic plans are selected by MODM models (goal programming). The algorithm is shown in Figure 3.

In this article, the researchers used the zero to one goal programming to choose the strategic plans. The model of zero to one goal programming is like the following formula:

$$\text{Max } G_1 : W_1 I_1 + W^2 I^2 + \dots Wn\ In$$

$$\text{Min } G_2 : C_1 I_1 + C^2 I^2 + \dots Cn\ In$$

$$\text{S. t: } gi(x) \leq \geq ; I = 1, 2, \dots, m$$

$$xi \{0,1\}, J = 1, \dots, n$$

The first objective (G1) is to maximize the importance of the strategic plan. Here, W is the measure or the importance of the strategic plan. The importance of the strategic plan was obtained by group decision making and the use of experts' consensus.

The second objective ($G_2$) is to minimize the cost of the strategic plan's implementation.

There are cost and logical limitations. "W" is the sign for the importance of the strategic plan, while "I" is the sign for the strategic plan and "C" is the sign for the cost of the strategic plan's implementation.

## RESULTS

A case study was conducted in the electronic and computer research center of the university which is active in the field of producing high industrial capacity monitoring systems. Four experts (comprising the managing director, commercial manager, financial manager and production manager) were selected and their opinions of four BSC's perspectives and four strategic objectives were taken for each perspective and the result were as follows (Dondangeh et al., 2008; 2009; 2010):

Step 1: By using experts' opinion, the framework from the

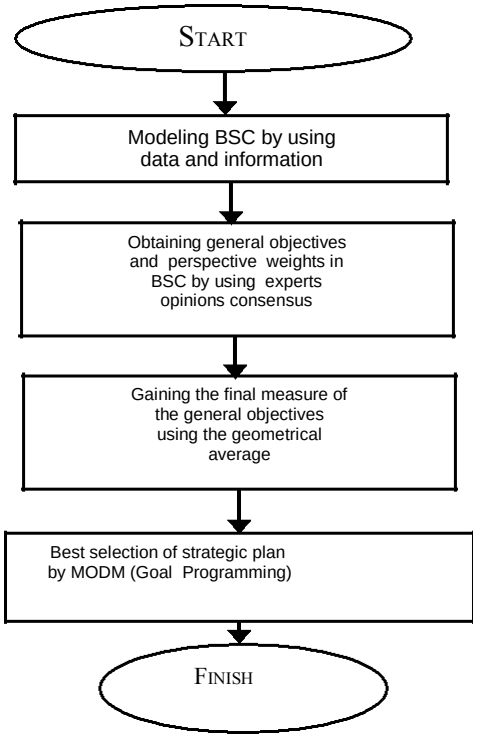


**Figure 3.** Best selection algorithm of strategic plans in BSC.

**Table 1.** Balanced scorecard model for electronic and computer research center.

| **Financial** | | | |
|---|---|---|---|
| **Objectives** | **Measures** | **Target** | **Initiatives** |
| Increasing income | 0.797 | 0.817 | I1-Marketing research |
| Increasing profit | 0.133 | 0.153 | I2- Marketing |
| Maximizing investment utilization | 0.004 | 0.004 | I3- Inventory control |
| Decreasing cost | 0.066 | 0.026 | I4- ABC |
| **Customer** | | | |
| Increasing of customer satisfaction | 0.27 | 0.236 | I5-After sales services |
| Increasing of market share | 0.027 | 0.024 | I6- Marketing research |
| Customer support | 0.541 | 0.505 | I7-CRM |
| Increasing of added value for customers | 0.162 | 0.236 | I8-Value engineering |
| **Internal processes** | | | |
| | **Measures** | **Target** | **Initiatives** |
| On time delivery | 0.07 | 0.06 | I9- Time and motion study |
| Product development | 0.873 | 0.886 | I10- QFD |
| Products' quality | 0.004 | 0.001 | I11- ISO 9000 |
| Continuous improvement | 0.052 | 0.054 | I12- TQM |
| **Learning and growth** | | | |
| Increasing of employees' satisfaction | 0.209 | 0.244 | I13- Increasing of personnel's' salary |
| Increasing of employees' productivity | 0.049 | 0.031 | I14- Personnel's evaluation system |
| Personnel's motivation | 0.697 | 0.698 | I15- Reward system |
| Increasing of informational skills | 0.045 | 0.028 | I16- MIS |

**Table 2.** Final weighting by consensus of experts' opinion.

| Final weight of financial perspective objectives | | Final weight of customer perspective objectives | | Final weight of internal processes perspective objectives | | Final weight of human resources perspective objectives | |
|---|---|---|---|---|---|---|---|
| 1 | 0.262750209 | 4 | 0.26553440 | 7 | 0.25466189 | 10 | 0.242216096 |
| 2 | 0.265570823 | 5 | 0.264367619 | 8 | 0.24651501 | 11 | 0.241994263 |
| 3 | 0.247798418 | 6 | 0.260530249 | 9 | 0.244923131 | 12 | 0.23384371 |

**Table 3.** Selection of strategic plans using goal programming.

| Variable | Selection | Strategic plans |
|---|---|---|
| I1 | Marketing researches | $Reject_0$ |
| I2 | Marketing | $Accept_1$ |
| I3 | Inventory management | $Accept_1$ |
| I4 | ABC | $Accept_1$ |
| I5 | After sales services | $Accept_1$ |
| I6 | Marketing researches | $Reject_0$ |
| I7 | CRM | $Accept_1$ |
| I8 | Value engineering | $Accept_1$ |
| I9 | Time and motion study | $Accept_1$ |
| I10 | QFD | $Accept_1$ |
| I11 | ISO 9000 | $Accept_1$ |
| I12 | TQM | $Reject_0$ |
| I13 | Increasing of personnel's salary | $Reject_0$ |
| I14 | Personnel's evaluation system | $Accept_1$ |
| I15 | Reward system | $Accept_1$ |
| I16 | MIS | $Accept_1$ |

BSC model is formed as shown in Table 1.

Step 2: By using the consensus of experts' opinion, the importance and objectives of BSC's perspectives, which are related to each perspective, are obtained.

Step 3: By using the following geometrical average of the final weight, the four perspectives (financial, customer, internal process and human resources) were calculated.

Finally, the study solves the problem through the use of the zero to one goal programming model.

The model of goal programming, which is the form of the problem, is as follows:

Max G1: 0.262750209 I1 +0.265570823, I2+0.256572961 I3+0.247798418, I4+0.265534401, I5+0.264367619, I6+0.258108369, I7+0.260530249, I8+0.254661897, I9+0.24651501, I10+0.24772033, I11+0.244923131, I12+0.242216096, I13+0.241994263, I14+0.237078527, I15+0.23384371, I16

Min G2: 5 I1+7, I2+3, I3+2, I4+4, I5+5, I6+2, I7+3, I8+4, I9+3, I10+3, I11+10, I12+20, I13+4, I14+3, I15+6, I16
S.T: 5 I1+7, I2+3, I3+2, I4+4, I5+5, I6+2, I7+3, I8+4, I9+3, I10+3, I11+10, I12+20, I13+4, I14+3, I15+6.

I16<=50
I1+I6=1
xi {0,1} , J = 1, … , n

The result of MODM (goal programming model) is shown in Table 3. In fact, the result shows the best selection of strategic plans in BSC model.

## DISCUSSION

One major problem in BSC performance is to choose the strategic plans (initiatives) by considering the limitations of budget and the time to achieve the strategic objectives. Since there is no proper method for selecting the strategic plan in the performance of BSC, the model presented solves this problem by using the zero to one goal programming method. Due to the fact that BSC is a conceptual model, which uses mathematical models and multi-objective decision making models (MODM), better results for selecting strategic plans can be presented.

Given that the relative importance of decision makers' opinions (people who evaluate) is not considered, the presented model solves this problem by considering the

relative importance of decision makers' opinions. Thus, the produced result is more accepted (Dodangeh, 2006).

## ACKNOWLEDGEMENTS

The authors are grateful to the Department of Industrial Management, Islamic Azad University, Science and Research Branch, Tehran and the Department of Mechanical and Manufacturing Engineering, University Putra Malaysia for their kind cooperation and support in carrying out this work. The study was also a part of an MSc thesis of Javad Dodangeh.

### REFERENCES

Charnes A, Cooper WW (1961). Management models and industrial application of linear programming. Wiley, New York.

Charnes A, Cooper W (1977). Goal programming and multiple objective optimizations: Part 1. Eur. J. Oper. Res., 1(1): 39-54.

Dodangeh J (2006). Master Thesis: Modeling of Fuzzy Balanced Scorecard. Master Thesis, Islamic Azad University, Science and Research Branch, Tehran, Iran.

Dodangeh J, Anisseh M, Mousakhani M (2008). Priority of strategic plans in BSC model by using Borda method. Paper presented at the 2008 International Conference on Wireless Communications, Networking and Mobile Computing, WiCOM.

Dodangeh J, Jassbi J, Mousakhani M., Anisseh M, Bt-Mohd YR (2008). Priority of strategic plans in BSC model by using of Group Decision Making Model. Paper presented at the 2008 IEEE International Conference on Industrial Engineering and Engineering Management, IEEM.

Dodangeh J, Mojahed M, Nasehifar V (2010). Ranking of Strategic Plans in Balanced Scorecard by Using Electre Method. Int. J. Innov. Manage. Technol., 1(3): 269-274.

Dodangeh J, Mojahed M, Yusuff RBM (2009). Best project selection by using of Group TOPSIS method. Paper presented at the 2009 International Association of Computer Science and Information Technology - Spring Conference, IACSIT-SC.

Ghodsypour H (2003). Multiple Objective Decision Making. Tehran, Iran: Amir Kabir University Publication.

Goodspeed SW (2003). Translating strategy into action: The balanced scorecard. Unpublished D.H.A., Medical University of South Carolina - College of Health Professions, United States -- South Carolina.

Ignizio J (1976). Goal programming and extensions (Vol. 26): Lexington Books Lexington, MA.

Kaplan R, Norton D (1996). The Balanced Scorecard, Translating Strategy into Action: Harvard Business Press.

Kaplan R, Norton D (1992). The Balanced Scorecard - Measures that drive performance. Harv. Bus. Rev., 70(1):71-79.

Kaplan R, Norton D (2008). MASTERING the Management System. Harv. Bus. Rev., 86(1): 62-77.

Lee S (1972). Goal programming for decision analysis: Auerbach Philadelphia.

Najmi M, Zarei B, Hosaini S (2001). BSC and EFQM Interaction or Conflict. Paper presented at the first conference of performance management, Tehran, Iran.

Zhang JLG, Ruan D, Wu F (2007). Multi-Objective Group Decision Making Methods, Software and Applications with Fuzzy Set Technique: Imperial College Press.