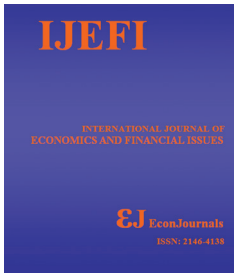

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Synergistic Role of Balanced Scorecard/Activity Based Costing and Goal Programming Combined Model on Strategic Cost Management

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ABSTRACT

During the past few years, we have seen a significant shift in cost accounting and management. In the new business environment, cost management has become a critical skill, but it is not sufficient for simply reducing costs; instead, costs must be managed strategically. Application of a successful strategic cost management (StraCM) system plays the significant role in success of organization performance. In this study, we want to illustrate how the goal programming model in combination with tools of the StraCM can affect in improving organizations' performance and optimize cost management decisions making. For this, we present a conceptual model with an integrated approach of balanced scorecard, activity based costing and goal programming model. Then for evaluating the proposed model, a numerical example with its solution procedure will be illustrated.

Keywords: Strategic Cost Management, Goal Programming, Balanced Scorecard, Activity Based Costing
JEL Classifications: L1, M41

1. INTRODUCTION

Strategic cost management (StraCM), much broader than simple cost analysis, is the utilization of cost information to "develop superior strategies en route to gain a competitive advantage." Whereas the traditional cost analysis examines the financial impact of individual management decisions, StraCM also deliberately uses cost information to support the business strategy. StraCM can improve the organization's cost structure and/or product and service performance by simultaneously analyzing its cost drivers, strategic position, and value chain to better assess key decisions (Ellram and Stanley, 2008). One of problems faced in StraCM, is that no tool exists to connect strategic costing principle with their implementation at the operational level (Venkatramanan, 2006).

With regard to weaknesses that exist in tools and techniques of StraCM, there has to be a method that can link costs to strategy of organization. In this study, we present a combined model of activity based costing (ABC)/balanced scorecard (BSC) and in order to optimize decisions, this Model is presented in a mathematical model (goal programming).

So far the pioneer studies that has been done in StraCM's tools and technique include Cooper (1996), Kaplan et al. (2004). The main parts of these studies focus on ABC and target costing. There are limited studies that link structure of cost management and BSC. Kaplan and Norton (1996) were the first group to design the BSC-ABC combined model. Venkatramanan (2006) applied this model for the first time in a health care study. Shapiro (1999) examined connections between cost-driven models for analyzing a firm's strategic plans, which uses ABC mathematical model and the resource-based view of the firm. However, no Study has been done to combine the BSC-ABC and goal programming.

Performance appraisal and implement of strategy are the key advantages of BSC framework, hence the structure of BSC integrated with organizational systems, such as the cost management system can have a synergistic effect on company performance and strategy implementation.

2. STRACM

This section briefly reviews the underlying concepts adopted by this research, such as the concepts of StraCM, their framework and tools.

2.1. Definitions of StraCM

StraCM is extensively applied in the accounting literature. The theoretical underpinning of StraCM lies in the economic model transaction cost analysis (Ellram and Stanley, 2008). StraCM is understood in different ways in literature. Shank and Govindarajan (1992) argued that StraCM could be defined as using cost information to do the following: help formulates and communicates strategies, carry out tactics that implement those strategies, and then develop and implement controls that monitor the success at achieving strategic objectives (Govindarajan and Shank, 1992). Cooper and Slagmulder argued that StraCM is the application of cost management techniques so that they simultaneously improve the strategic position of the firm and reduce costs. Furthermore, Cooper argued that StraCM need to include all aspects of production and delivering the product. So, StraCM should be inherent to each stage of a product's life cycle (Cooper et al., 1997).

2.2. Framework of StraCM

A framework that recommended for StraCM encompassing: (1) Value chain analysis, (2) strategic positioning analysis, (3) cost driver analysis. These three practices arguably provide a source of competitive advantage. None of these approaches itself represents StraCM rather the combination of these three items that constitute StraCM (Ellram and Stanley, 2008).

2.3. Tools of StraCM

StraCM is a set of reliable techniques. These techniques or tools may be used individually to support a specific goal or together to serve the overall needs of the organization (El Kelety, 2006). Some of the practices that have been related as supportive of StraCM include: Total cost of ownership analysis, target costing, and activity-based costing (Ellram and Stanley, 2008). A set of StraCM techniques that are used together to support the organization's goals and activities are called StraCM system (Hilton et al., 2003). When designing a cost management system, it must be considered many tradeoffs such as costs and benefits of the cost management system (El Kelety, 2006).

3. BSC

Kaplan and Norton (1992) originally introduced the BSC. During next decades, it called "Strategic management system." Not only this method applied for performance evaluation, but also it uses as a framework for formulate of strategy, communication and control of strategy implementation (Kaplan and Norton, 2001). Evidence suggests that managers tend to weight financial measures more heavily than non-financial measures for reasons such as outcome effects, outside pressure, and familiarity (Cardinaels and van Veen-Dirks, 2010). Whereas apply performance evaluation systems by non-financial measures are suggested in order to enhance strategy implementation. Performance measurement systems is strategy tool, because they contribute towards strategic objectives through three mechanisms: (i) A better understanding of the linkages between various strategic priorities; (ii) more effective communication of the association between objectives and actions; and (iii) more efficient allocation of resources and tasks (Dossi and Patelli, 2010). Kaplan and Norton (1996) stress the importance of adhering to three principles in developing BSC: Maintaining cause-and-effect relationships, comprising sufficient performance drivers and keeping a linkage to financial measures. They also emphasize that the BSC is only a template and must be customized for the specific elements of an organization or industry. Depending on the sector in which a business operates and on the strategy chosen, the number of perspectives can be enlarged, or one perspective can be replaced by the other (Martinsons et al., 1999).

4. THE SYNERGISTIC EFFECT OF BSC AND StraCM

In order to demonstrate the synergistic effect of BSC and StraCM, we argue by two reasons. First, BSC is as linkage tool between cost management and strategy and another reason is the synergistic effect of BSC by value chain analysis approach. One of the problems faced in StraCM is that no tool exists to connect strategic costing principles with their implementation at the operational level (Venkatramanan, 2006). However StraCM tools can help in providing important information for strategy formulation, evaluation of strategy implementation, and highlighting the practical limitations or problems with the adopted strategy (Shank and Govindarajan, 1993). Furthermore, as the complexity of operation increases, StraCM tools tend to become time-consuming and expensive to implement and maintain (Kaplan and Norton, 1992). A combined model of BSC and StraCM tools can adapt the strategic BSC dimensions, and use them as a means of collecting, organizing, and analyzing activity and cost information. This would overcome the above mentioned limitation by organizing complex activity and cost data, and by providing a clear strategic link between dimensions of activity, cost information, and strategic goals. BSC is a performance management tool that identifies quantifiable performance measures and targets and links them to a unified strategy (Kaplan and Norton, 1996).

In order to do this, the BSC defines performance dimensions that are critical to strategy achievement. These dimensions are termed "perspectives" (Kaplan and Norton, 1992). A StraCM tool could create this link by taking advantage of the BSC principle that allows it to relate performance to achievement of strategic goals (Kaplan and Norton, 2001). By clearly defining the goals of an organization and then identifying the different dimensions of activity and activity costs that are directed towards that purpose, an explicit link can be created between activities, resource utilization, and objectives. This can provide a more strategic orientation to cost management at the operational level (Venkatramanan, 2006).

Moreover, one of the most important concepts of StraCM is value chain analysis. The initial step in undertaking strategic cost analysis is to identify the firm's value chain (El Kelety, 2006).

A company cannot reduce costs and/or create value for customer by looking at its activities as a whole. Creating competitive advantage originates from many separate activities a company performs in designing, production, marketing, delivering, and supporting its products (Porter, 1998). Each of these activities can contribute to improve a company's cost position and customer value (El Kelety, 2006). The BSC measures organizational performance

from four perspectives, including financial, customer, internal business process, and learning and growth, in relation to the four functions of accounting and finance, marketing, value chain, and human resource (Wu et al., 2009).

The BSC scheme integrates the interests of the key stakeholders, customers and employees on a scoreboard. The essence of BSC lies in seeking a balance between financial and non-financial measures (Wanga et al., 2010). These assets have to integrate in a set with other assets for value creation. BSC method provides a framework for description of strategy, by mean of connecting tangible and intangible assets in value activities (Kaplan and Norton, 2001). This selection process requires knowledge of the cost and value of each activity. With value chain analysis, the StraCM efforts are focused on improving the strategic activities of the company, trace costs to value chain activities, and use the activity-cost information to manage the strategic value chain activities better than other companies. For example, in customer perspective of BSC framework, proposed value to customer and how this value is resulted to growth and profitability for stockholders, is a substructure of strategy. Porter argued, decentralization on special segment of customers and their desirable values, lead to organizations cannot achieve the competitive advantage or in internal business process perspective, organizations have to recognize the processes that can create value for customers and ultimately their stockholders. Organization's activities lied to internal business processes and constitute value chain of organization (Kaplan and Norton, 2001).

5. CONCEPTUAL - MATHEMATICAL MODEL

In this section, we presented a combined model of BSC and ABC. Then for optimizing decisions, we proposed application of a mathematical model (goal programming model). ABC technique is the most application systems in costing of product, but it can't find answers for following questions: How to allocate resources to manufacturing activity in order to minimizing a total cost? What is optimum combination of corporation productions? How production activities in order to minimize the overall costs and access to the desired level of production should be used? How can assume different objectives for a corporation? In addition, is it considered in strategic planning?

Furthermore, in many organizations, especially in the manufacturing sector, the resources which are used in the processes of the value chain can be categorized into manufacturing resources and non-manufacturing resources. Manufacturing resources refer to the resources that immediately enter manufacturing processes, such as the parts that are assembled into a car. On the other hand, non-manufacturing resources include the resources that are used in non-manufacturing processes such as research and development. Non-manufacturing resources that are used across the value chain processes had long received far less attention in the manufacturing sector (Hilton et al., 2003).

In comparison to manufacturing resources, non-manufacturing resources cover a wider range of resources; they typically represent a significant portion of the cost structures of some organizations. The relevant expected costs include all costs that can be identified across the value chain. The processes and activities that the organization employs across the value chain determine how it uses its resources. Following model is presented for solving these problems. Figure 1 is illustrated the conceptual model of the research.

Step 1: Application of BSC:
We define perspectives of BSC that are vital for access of strategy. With acceptance strategic dimensions of BSC, we can be used them as a framework to collect, classify and organize activity information and cost. In order to this, initial step, getting the clear perception of corporation processes. It is applied by identifying important activity dimensions. Then developing list of activities and creating an initial model. Figure 2 is a generic representation of a combined ABC/BSC model using the activity dimensions presented by Kaplan and Norton (1996). Information collection is doing base on categorization of identified activities in activity dimensions. This information is based on previous literature and interview with managers and experts in the organization.

Step 2: Application of ABC:
ABC is centralized on activities as basic factors of cost and using activities' costs as main structure for gathering costs. In this system, the argument is that production need to doing various activities and activities are consumer of resources. So, in ABC, initially overhead costs allocate to activities. Then allocated costs to activities base of factors that named "cost driver," allocating them to products or production lines. ABC system identifying, operational organization costs, relation between these costs and performed activities, relationship of final performed activities with manufacturing's products and serves.

Main goal of ABC system is identification and elimination of activities and costs that have no value added. Generally, in this stage, we perform cost collection and information of

Figure 1: The conceptual model of the proposed approach

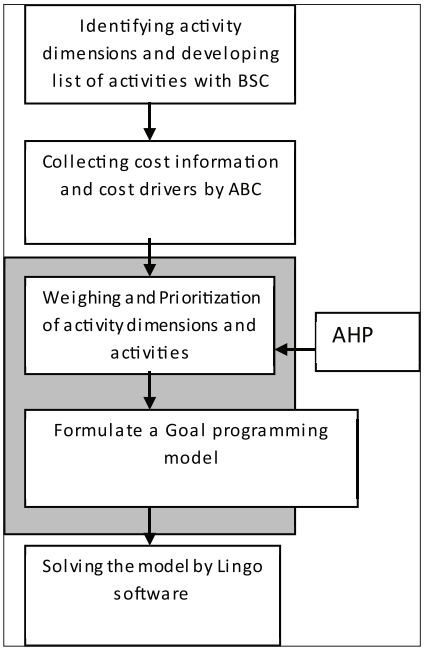
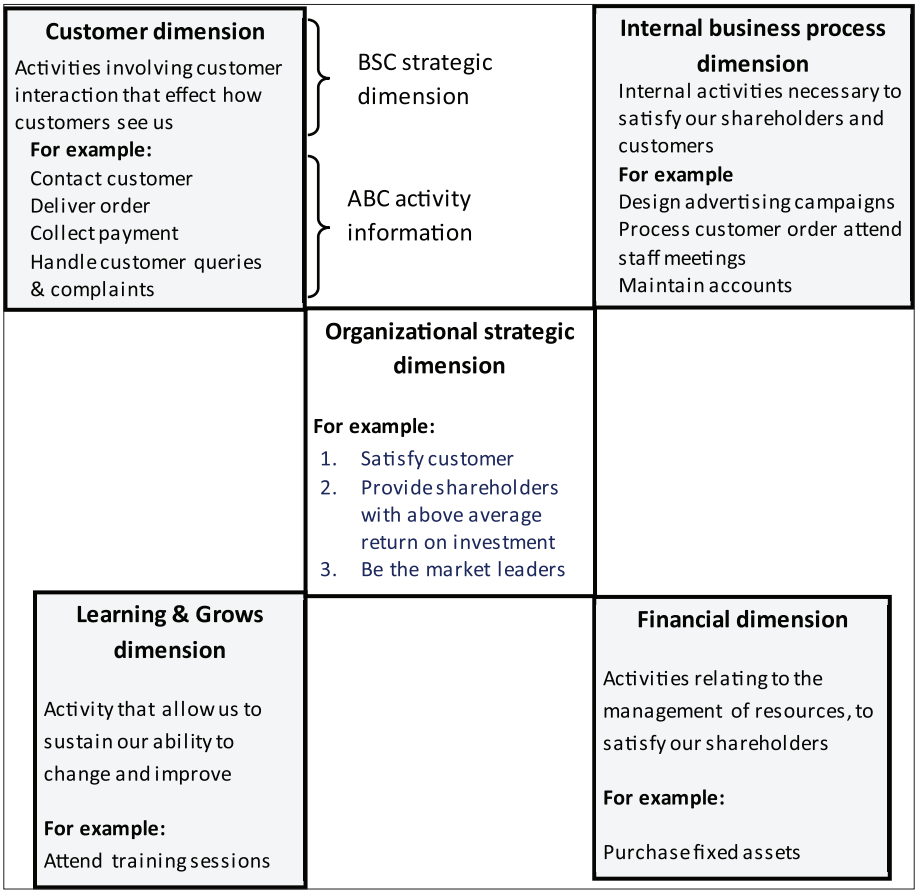


Figure 2: Adapted from generic representation of the activity based costing/balanced scorecard model by Kaplan and Norton (1996)



cost drivers; it consists of work on gathered information in previous stage to estimate costs of activity dimensions and cost objectives. It performed by gathering cost resources for processes, link processes to each objective of cost, calculate cost of each unit cost driver, and at finally allocating costs of cost's objectives.

Step 3: Application of analytic hierarchy process (AHP):
Goal programming is a capable tool to considering simultaneously several factors in decision making. A problem that has to consider in this model is how prioritizing goal, constraints and coefficient of penalty take into account for each deviation. Goal programming can't perform it. Furthermore, application of intangible and qualitative criteria is out of capable this programming. So use of AHP can cover weaknesses of goal programming. Finally, it can provide an adequate model for organization's decision-making. AHP can use for prioritizing perspectives of BSC, if has been used ordinal ranking in goal programming.

P_i is a priority of the activity, for example, if goals related to internal process perspective as production and marketing costs have high importance than goals inside customer perspective as advertisement and guarantee costs, in this state, minimizing additive weight of undesirable deviations of internal process perspective that have more priority, and this perspective is P_1 and goals inside customer perspective is P_2. In cases where deviation variables have a same measurement unit, for example, if overall goals in internal process perspective were unitize dollar, in this state have to use cardinal ranking. For getting specific weight to each variable can use AHP method. Otherwise, several heterogeneous units (dollar, market's share) cannot use of this method. Goal programming has ability to simultaneous use of both ordinal and cardinal weighing. We use of experts' opinions for doing pair wise comparisons in AHP method.

Step 4: Presentation mathematical model by goal programming:
One of the decision-making methods with multiple objectives is goal programming. Basic of goal programming is identification specific number as a goal for each of objectives, then formulating related objective function and answer is searched to minimized additive weight of undesirable deviations of each objective than the goal is identified for them (Schrage, 2003).

Positive deviations are usually displayed by d_t^+ and negative deviations are displayed by d_i^-. Each of two deviations must be non-negative. Goal programming models are constituted of four critical sections:

1. Decision variables: Decision variables of goal programming are similar decision variables in linear programming
2. Systematic constraints: This constraints display crisp constraints and no deviation allow in them. System and crisp constraints must be satisfied firstly, before a goal constraint is considered

3. Goal constraints: Goal constraints display desire levels or specific value that must be access to it
4. Objective function: Objective function in goal programming model is formulated to minimize additive of undesirable deviations. So, structure of function related to weighting system to objectives (Jones and Tamiz, 2010).

Suggested goal programming model is presented in following:

$$MinZ = P_1W_1(w_1^{'}d_1^{+} + w_2^{'}d_2^{+} + \cdots + w_n^{'}d_n^{+}) + P_2W_2(w_{n+1}^{'}d_{n+1}^{+} + w_{n+2}^{'}d_{n+2}^{+} + \cdots + w_m^{'}d_m^{+}) + P_3W_3(w_{m+1}^{'}d_{m+1}^{+} + w_{m+2}^{'}d_{m+2}^{+} + \cdots + w_k^{'}d_k^{+}) + P_4W_4(w_{k+1}^{'}d_{k+1}^{+} + w_{k+2}^{'}d_{k+2}^{+} + \cdots + w_t^{'}d_t^{+})$$

Subject to:

$$\sum_{j=1}^{n} a_{ij}x_j + d_i^{+} + d_i^{-} = b_i\,(i = 1,2,\ldots,m)$$

$$\sum_{j=1}^{n} a_{ij}^{'}x_j \le b_i^{'}\,(i = 1,2,\ldots,m)$$

$$d_i^{-} * d_i^{+} = 0$$

$$x_j, d_i^{-}, d_i^{+}, b_i, b_i^{'} \ge 0$$

P_i (i: 1, 2, 3, 4): Denoting priority of BSC perspectives that their cost deviations must be minimized,

W_i (i: 1, 2, 3, 4): Weights allocated to each dimension of BSC that calculated by AHP,

$W_t^{'}$: Weights allocated to deviation variables, that calculated by AHP,

d_i^{+}, d_i^{-}: Respectively, are as positive and negative deviations,

a_{ij}: Represent consumption coefficients of resource/activity,

$b_i^{'}$: Desirable level of goals.

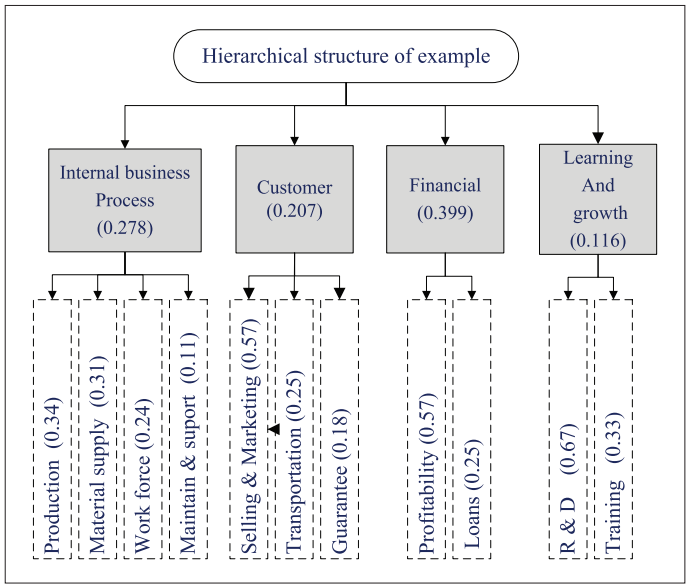
Objective function of goal programming model constituted of four segments. These four segments defined in base of four goal constraints. First segment, minimized cost deviations in Finance dimension, second, third and fourth segments, respectively displayed cost deviations of internal business processes, customer, learning and growth (Figure 3). It is necessary to calculate importance's coefficient (degree) and priority, for each section of deviation.

6. AN EMPIRICAL EXAMPLE

To assess the proposed model, we examined it in one of the car manufacturing industries in Iran. Automotive industry is a strategic and important industry. Therefore, implementing a successful StraCM system can play an important role in the success of these organizations and achieve them strategic objectives. Hence, Iran Khodro Company has been established below strategies:

- Moving toward the targeted cost management system in Iran Khodro group
- Identification costing system to determine effective cost

Figure 3: Hierarchical structure of example on balanced scorecard framewor



- Identify the appropriate system of internal activity cost (products and services) between Iran Khodro companies.

Regardless of the type of strategy, organizations should offer acceptable price to their customers.

With increased competition between domestic and foreign automakers, customers will not pay any price to purchase their desired vehicle. Collecting data about model parameters was very time consuming and difficult. Because, the main focus of this model is the cost data that offering them have limitations. However, with given limitations, we attempted to test the mathematical model for production of two automobile Models A and B.

6.1. Decision Variables and Parameters

Variables:

x_1: Number of Model A, which must be produced.

x_2: Number of Model B, which must be produced.

Parameters:

P_i (i: 1, 2, 3, 4): Denoting priority of BSC perspectives that their cost deviations must be minimized,

W_i (i: 1, 2, 3, 4): Allocated weights to each dimension of BSC calculated by AHP for prioritizing the goals,

$W_t^{'}$: Weights assigned to deviation variables that resulted by AHP,

d_i^{+}, d_i^{-}: Denoting positive and negative deviations,

d_t^{+} (t: 1., 18): Undesirable deviations of internal business process dimension,

(t: 19, 20, 21): Undesirable deviations of customer dimension,

(t: 23): Undesirable deviations of financial dimension (loan),

(t: 24, 25): Undesirable deviations of learning and growth dimension,

d_{22}^{-}: Undesirable deviations of financial dimension (profitability),

y_i (i: 10, 11., 19): Authorized distributors of Model A,

y_j (j: 20, 21., 29): Authorized distributors of Model B.

Table 1: Data/cost drivers related to the consumption of resources

Activities	Unit	Target cost (Rial)	Unit cost (Rial)	Cost rate	Model
Production					
Assembly	Unit-hour/worker	4,550,500	13,000	12.5	A
				14.7	B
	Unit-hour/supervision	3,757,500	22,500	9	A
				13.5	B
	Raw material	14,965,000	45,000	56	A
				33	B
Machining	Unit-hour/worker	8577,000	13,000	22.5	A
				28.8	B
	Unit-hour/supervision	5,515,000	23,500	14	A
				19	B
	Raw material	3,526,000	34,000	89	A
Painting	Unit-hour/worker	5,535,000	14,500	122	B
				18	A
				15	B
	Unit-hour/supervision	3,607,500	27,000	12	A
				9.5	B
	Raw material	43,425,000	175,000	138	A
Cutting	Unit-hour/worker	12,215,000	12,500	121	B
				34	A
	Unit-hour/supervision	8.277.500	19,500	39	B
				22	A
	Raw material	2,6850,000	335,000	27.5	B
				90	A
Press	Unit-hour/worker	6,230,000	13,500	70	B
				25	A
	Unit-hour/supervision	3,107,500	21,500	12	B
				11	A
	Raw material	9,075,000	189,000	7.5	B
				33	A
				21	B

Table 2: Cost consumption coefficient and production capacity

Activities	Aspiration level (Rial)	Model A (Consumption coefficient)	Model B (Consumption coefficient)
BSC perspectives			
Internal business process			
Production cost	1.4E+09	4500	3700
Material supply	*	*	*
Work force	*	*	*
Maintain and support	Fuel (3,000,000)	7	8
	Electronic (3,500,000)	10	10
Customer			
Selling and marketing cost	1E+10	28,000	30,000
Transportation	5.99E+09	18,000	19,000
Guarantee	3E+09	5000	9000
Finance			
Profitability	1.59E+09	5000	4500
Loans	630,000,000	2000	1500
Learn and grow			
R and D	1.26E+09	3000	4000
Training	1E+09	1900	2500
Systematic constraint			
Production capacity (volume)	-	180,000	170,000
Total cost per unit (Rial)	-	85,000,000	70,000,000

*They were described in Table 1. R and D: Research and development, BSC: Balanced scorecard

Budget constraints for both Models A and B are 26000000 million Rials and other cost details have mentioned in Tables 1 and 2.

The general model of goal programming can be written in the following manner:

$$MinZ = P_1(0.399)(0.75d_{23}^- + 25d_{22}^+) + P_2(0.278)\ (0.34d_1^+ + 0.31d_2^+ + 0.31d_3^+ + 0.31d_4^+ + 0.31d_5^+ + 0.31d_6^+ + 0.24d_7^+ + 0.24d_8^+ + 0.24d_9^+ + 0.24d_{10}^+ + 0.24d_{11}^+ + 0.24d_{12}^+ + 0.24d_{13}^+ + 0.24d_{14}^+ + 0.24d_{15}^+ + 0.24d_{16}^+ + 0.11d_{17}^+ + 0.11d_{18}^+) + P_3(0.207)\ (0.57d_{19}^+ + 0.25d_{20}^+ + 0.18d_{21}^+) + P_4(0.116)\ (0.67d_{25}^+ + 0.33d_{24}^+)$$

Goal constraints:

$4500X_1 + 3700X_2 - d^+_1 + d^+_1 = 14{,}000$ - Goal constraints of production,

$56X_1 + 33X_2 - d_2^+ + d_2^+ = 149$ - Goal constraints of assembly (stock material),

$89X_1 + 122X_2 - d_3^+ + d_3^+ = 35{,}260{,}000$ - Goal constraints of work by machine (stock material),

$138X_1 + 121X_2 - d_4^+ + d_4^+ = 43{,}425{,}000$ - Goal constraints of painting (stock material),

$90X_1 + 70X_2 - d_5^+ + d_5^+ = 26{,}850{,}000$ - Goal constraints of cut (stock material),

$33X_1 + 21X_2 - d_6^+ + d_6^+ = 9{,}075{,}000$ - Goal constraints of press (stock material),

$12.5X_1 + 14.7X_2 - d^+_7 + d^+_7 = 45$ - Goal constraints of assembly (unit-hour/worker),

$9X_1 + 13.5X_2 - d_8^+ + d_8^+ = 37$ - Goal constraints of assembly (unit-hour/supervision),

$22.5X_1 + 28.8X_2 - d_9^+ + d_9^+ = 85$ - Goal constraints of work by machine (unit-hour/worker),

$14X_1 + 19X_2 - d_{10}^+ + d_{10}^+ = 5{,}515{,}000$ - Goal constraints of work by machine (unit-hour/supervision),

$18X_1 + 15X_2 - d_{11}^+ + d_{11}^+ = 5{,}535{,}000$ - Goal constraints of painting (unit-hour/worker),

$12X_1 + 9.5X_2 - d_{12}^+ + d_{12}^+ = 36$ - Goal constraints of painting (unit-hour/supervision),

$34X_1 + 39X_2 - d^+_{13} + d^+_{13} = 122$ - Goal constraints of cut (unit-hour/worker),

$22X_1 + 27.5X_2 - d_{14}^+ + d_{14}^+ = 8{,}277{,}500$ - Goal constraints of cut (unit-hour/supervision),

$25X_1 + 12X_2 - d^+_{15} + d^+_{15} = 62$ - Goal constraints of press (unit-hour/worker),

$11X_1 + 7.5X_2 - d_{16}^+ + d_{16}^+ = 3{,}107{,}500$ - Goal constraints of press (unit-hour/supervision),

$7X_1 + 8X_2 - d_{17}^+ + d_{17}^+ = 3{,}000{,}000$ - Goal constraints of fuel,

$10X_1 + 10X_2 - d_{18}^+ + d_{18}^+ = 350000$ - Goal constraints of electronic,

$28{,}000X_1 + 30{,}000X_2 - d_{19}^+ + d_{19}^+ = 10{,}000{,}000{,}000$ - Goal constraints of marketing and selling,

$18{,}000X_1 + 19{,}000X_2 - d_{20}^+ + d_{20}^+ = 5{,}990{,}000{,}000$ - Goal constraints of transportation,

$5000X_1 + 9000X_2 - d^+_{21} + d^+_{21} = 3{,}000{,}000{,}000$ - Goal constraints of guarantee,

$2000X_1 + 1500X_2 + d^+_{22} + d^+_{22} = 6300$ - Goal constraints of profitability,

$5000X_1 + 4500X_2 - d^+_{23} + d^+_{23} = 15{,}900$ - Goal constraints of getting loans,

$1900X_1 + 2500X_2 - d^+_{24} + d^+_{24} = 1{,}000{,}000{,}000$ - Goal constraints of R&D,

$3000X_1 + 4000X_2 - d^+_{25} + d^+_{25} = 1{,}260{,}000{,}000$ - Goal constraints of training,

Systematic constraints:

$X_1 \le 180{,}000$

$X_2 \le 170{,}000$

$85X_1 + 70X_2 \le 26{,}000{,}000$

Constraints of automobile demands by authorized distributors:

$y_{10} + y_{11} + y_{12} + y_{13} + y_{14} + y_{15} + y_{16} + y_{17} + y_{18} - x_1 \le 0$

$y_{20} + y_{21} + y_{22} + y_{23} + y_{24} + y_{25} + y_{26} + y_{27} + y_{28} + y_{29} - x_2 \le 0$

$Y_{10} \ge 15{,}000,\ Y_{11} \ge 13{,}400,\ Y_{12} \ge 11{,}600,\ Y_{13} \ge 12{,}000,\ Y_{14} \ge 13{,}500,\ Y_{15} \ge 12{,}000,\ Y_{16} \ge 13{,}000,\ Y_{17} \ge 13{,}500,\ Y_{18} \ge 9000,\ Y_{19} \ge 9500,\ Y_{20} \ge 13{,}500,\ Y_{21} \ge 11{,}000,\ Y_{22} \ge 9450,\ Y_{23} \ge 11{,}000,\ Y_{24} \ge 11{,}500,\ Y_{25} \ge 9500,\ Y_{26} \ge 12{,}500,\ Y_{27} \ge 11400,\ Y_{28} \ge 6000,\ Y_{29} \ge 6000.$

7. RESULT

After solving problem with the Lingo software, according to Table 3, following results has obtained and in seven cases of activity, deviation from ideal has observed.

In addition, we could obtain the optimal level of production that in this example is two model of automobile (Table 4).

8. CONCLUSIONS

This study proposed an effective combined model of BSC/ABC and goal programming for solving problems such as optimum allocation of resources to valuable activities, StraCM and access to strategic objectives like cost leadership. In addition, this model can improve the capability of mathematical models like goal programming to optimize decision-making and calculate the optimum level of production.

Table 3: Amounts deviations from goals

Kind of activity	Amount deviation from goal (1000 Rial)
Production	
Assembly (stock material) (d_2^+)	85769.23
Cut (stock material) (d_5^+)	85769.23
Press (stock material) (d_6^+)	40384.62
Painting (unit-hour/supervision) (d_{12}^+)	2500
Press (unit-hour/worker) (d_{15}^+)	56153.85
Press (unit-hour/supervision) (d_{16}^+)	10192.31
Customer	
Transportation (d_{20}^+)	0.17769

Table 4: Optimum level of production

Kind of automobile	Optimum number of production
Model A (x_1)	175,384
Model B (x_2)	158,461

The main benefits of the an integrated system of ABC/BSC and goal programming presented in this study can establish a communication system that bridges the existing gap between StraCM and making optimum and strategic decisions.

In this study, we adopted a goal programming model to solve the proposed ABC/BSC model, difficult to quantify and cause-and-effect relationship among various perspectives. An important advantage of this approach is that the interaction of the perspectives and activities can we clearly identified, also applied AHP structure can create clear perception of experts' tendency in the organization. We could gather experts' opinions and allocate weights of each perspectives and key activities through the pair wise comparisons. This weighting system can be effective in the decision making process and optimum allocation of resources and access to cost targets.

Future studies may extend the combined model with other tools and techniques of StraCM. Finally, this model can be used to other industries.

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