Casual strategy mapping using integrated BSC and MCDM-DEMATEL

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Abstract: Our environment is known with competition increasing in global economic and business strategies. The clear importance of effective management of business strategy map has become absolutely necessary. Strategy mapping represents a structured and general framework for strategic goals and plays an important role in formulating business competition and organization performance formulating. It is important to rank factors influencing strategy map and prioritize the strategies based on suitable factors. In this paper, a casual model was settled for mapping of strategic plans in Balanced Scorecard (BSC). We developed the map with integration of BSC and MCDM-DEMATEL technique to rank different business strategies for organization performance formulating. The proposed map is based on experiences of experts in real business world.
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Introduction

Managers need to know where is better to spend their money and which strategy has priority over others in their organization. The aim of this study is ranking different strategies and providing all aspects which are defined in Balanced scorecard (BSC) theory for system performance. We try to propose the strategy map that is dynamic, generalized and strategy based.

BSC is an approach to strategic planning system which is widely uses in strategic systems. BSC's aspects are mostly selected from four financial, customer, internal factors and learning and growth perspectives (Kaplan and Norton, 1992). These indices are required for a perfect performance analysis system and general formation of a set of organization strategic planning for all acts of any system.

BSC approach concentrates on the important issues for business systems, issues such as effective measuring of performance and formulating strategies as well as evaluating the strategies (Goodspeed, 2003). One of the most noticeable ability of BSC is maintaining the balance among:

1. Short-term activities and long-term strategies
2. Short term and long term objectives
3. non-financial indexes and financial indexes

These characteristics propose BSC as it can be used as a framework for classifying the measuring indexes and criteria for evaluating a set of strategies in different parts of a system.

Considering the importance of strategic planning in business systems and creating the competitive advantage for the mentioned system an integrated transaction among business competitive, complex and dynamic environment; BSC experts believe that successful formulation of organization strategy depends on the issue that organizational strategist understand and conceive the strategies. Note that, this issue requires creating complicated processes, which cause organizational illogical assets and investments direct to a logical output. BSC experts have introduced instruments, which could indicate the link between structures of organization strategies by identifying key objectives of organization and conceptualization of causal relations among them as Kaplan and Norton (2000) stated. In this study we try to develop a strategy map by focusing on the concepts of BSC. The concepts are defined as table 1 shows. This table is adapted from Dodangh et al (2010).

Decision making modeling

Decision making consist of two methods (Dodangh et al, 2010). The first one is Trial and Error method which consist of following steps

1. Face to reality
2. Select one of substitutes and
3. Monitor the result.

In this level, decision makers change decisions and choose other alternatives, if there are enormous decision errors or create a big problem.

The second one is modeling method that includes:

1. Models the real problems in system
2. Determine Specifies Elements and their Effect on Each Other in system
3. Analysis Model and predicting real system's problems

Table 1. BSC perspectives and their strategy concepts

BSC Perspectives	Strategies
Financial(F)	Income increasing (II) Profit increasing (PI) Maximize of Investment Utilization (MIU) Cost decreasing (CD)
Customer(c)	Increasing of customer satisfaction (ICS) Increasing of Market share (IMS) Customer Supporting (CS) Increasing of added value for customers (IAVC)
Internal factors(IF)	On time delivery (OTD) Product development (PD) Products Quality (PQ) Continues improvement (CI)
Learning and growth(LG)	Increasing of employees satisfaction (IES) Increasing of employees productivity (IEP) Personnel's Motivation (PM) Increasing of informational skills (IIS)

Modeling based multi-criteria system is divided into two main directions:

The first approach is improving individual multi-criteria models that take into individuals' priorities, each member of decision making group determines a multi-criteria problem, and then factors are validated by considering to his preference and finally get series of solutions after solving the problem. At the end aggregation operators provide the group solution by aggregating the separated consequences. In the second approach, each group member presents a set of parameters which are aggregated by appropriate operators after multi-criteria model is developed for the entire team. Finally a group alternatives will be set. Upon this set the multi-criteria method is practical and the solution expresses group (Matsatsinis et al , 2005; Rigopoulos et al, 2008).

Many methods which are based on multiple attribute utility theory (MAUT), had developed to deal with the problems of multiple criteria decision making (MCDM) (Khosravi et al, 2011). MAUT is based to aggregate all criteria for evaluating alternatives by determining unique-dimension which is called utility function to evaluate alternatives (Gwo-Hshiung et al, 2009). Utility independence or utility separability is usually the basic assumption in MAUT but also it is The important problem in MAUT (Grabisch, 1995; Hillier, 2001).

On the other hand in the practical problems, we can establish the proper MADM methods based on the results of structural models by clarify the structure among criteria (Gwo-Hshiung et al, 2009; Betty Chang et al, 2001). Decision Making Trial and Evaluation Laboratory (DEMATEL) is the one of methods which can make clear the structure between criteria (Huang and Tzeng 2007; Liou James et al. 2007) for solving MCDM problems.

Decision Making Trial and Evaluation Laboratory

Decision making trial and evaluation laboratory (DMATEL) method is one of the powerful decision making group that enables decision makers to distinct the complicated criteria of a system (or subsystem) into the cause and effect groups to simplicity the process of decision making (Wu et al,2007) and also recognize direct and indirect influences between complex factors (Chen et al,2011; Zhouet et al, 2011).

Fontela and Gabus had applied DEMATEL method at the end of 1971 and it was used to explain most of complex global problems in economic, scientific and political area (Gabus and Fontela, 1974; Gabus and Fontela, 1976)

The research aims to calculate the causal relationship and strength throughout criteria and getting direct and indirect influences among criteria and achieve a connecting diagram of interdependent factors by using the DEMATEL technique. In addition the gaps between the interactive relations of those criteria have been filled by this method whereas it doesn't need a lot of data (Wen-Shiung et al, 2009; Zhou et al, 2011). Prioritizing the criteria according to the kind of relationships and illuminating the interactions among complex factors (Ru-Jen, 2011; Maghsud Amiri et al 2011).

Methodology

The procedures of the DEMATEL method can be expressed as follow:

Step 1: Calculating the direct-relation matrix. In this study for measuring the relationship among different criteria four scales is used:

0 = no influence
1 = low influence
2 = high influence
3 = very high influence

After that, sets of the pair-wise comparisons in the sense of effects and direction between criteria are prepared by decision makers. Then the direct-relation matrix gives the primary data as an $n \times n$ matrix (A) where each component of *aij* is indicated as the degree in which the criterion i affects the criterion j.

Step 2: In this step direct-relation matrix must be normalized. By applying the following formulas normalization will be performed:

$$\frac{1}{k} = \max 1 \le i \le n \sum_{j=1}^{n} aij \qquad i, j = 1,2,\ldots n$$

$$X = A \times k$$

Note that each element x_{ij} of matrix $\boldsymbol{X}$ is between zero and less than 1.

Step 3: Calculating the total-relation matrix that will be obtained by following formula.

$$T = X(I - X)^{-1}$$

Note that I is the *n x n* identity matrix.

Step 4: creating a causal diagram. The sum of rows is indicated vector D $[d_i]n \times 1$ which determines the total effects, both direct and indirect by factor *i* to the other factors, also the sum of columns is represented vector R$[\ r_j\ ]_{n\times n}$ that shows the total effects, both direct and indirect, received by factor *j* from the other factors.

Then, the horizontal alignment vector (D + R) named "Prominence'' reveals the degree of importance (total sum of effects given and received) of each criteria that is made by adding D to R.

Similarly, the vertical axis (D - R) named ''Relation'' that shows the net effect that factor *i* contributes to the system, it is made by subtracting D from R. criteria could be divided into a cause and effect groups. In general, the criterion will be to the cause group if (D - R) is positive, and when the (D - R) is negative, the criterion represents the effect group. Consequently with dataset of (D+R, D-R) the casual diagram could be obtained.

$$T = [t_{ij}]_{n\times n} \qquad i, j = 1, 2, \ldots, n$$

$$D = \left[\sum_{j=1}^{n} t_{ij}\right]_{n\times 1} = [t_{i.}]_{n\times 1}$$

$$R = [\sum_{i=1}^{n} t_{ij}]_{1\times n} = [t_{.j}]_{1\times n}$$

Step 5: Acquire the inner dependence matrix by the normalization method. By this way the sum of each column in total-relation matrix is equal to 1.

Results

We had an interview with people who have the knowledge about system performance and strategy for gathering committee of decision makers. It is important to find experts who can determine the relationships among the influential factors of strategy mapping. In addition Type of organization activities and field of actions determine the obtainable relationships between balanced scorecard perspectives. In this part we can find the relation among significant factors in each perspective. Priorities of BSC perspectives and their criteria are measured by DEMATEL technique. Casual diagram which includes horizontal axis (D+R) and vertical axis (D-R) is prepared. Relative importance of each feature is shown in horizontal axis that is called "Prominence" similarity features are divided to cause and effect group in vertical axis that is called "Relation". Besides, complex causal relationships aspects are visualized into observable structural model by casual diagram (Tzeng et al, 2010). However if (D-R) is negative, this aspect belongs to the effect group; alternatively if (D-R) is positive, the aspect belongs to the cause group. The relative importance of criteria is determined by committee of expert decision makers. The relations among essential factors which are proposed in BSC and BSC perspectives are illustrated in Fig 1, Fig 2, Fig 3, Fig 4, and Fig 5.

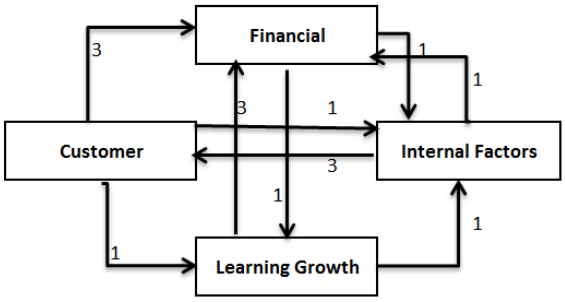

Fig.1. the relationships in Balanced Scorecard Perspectives

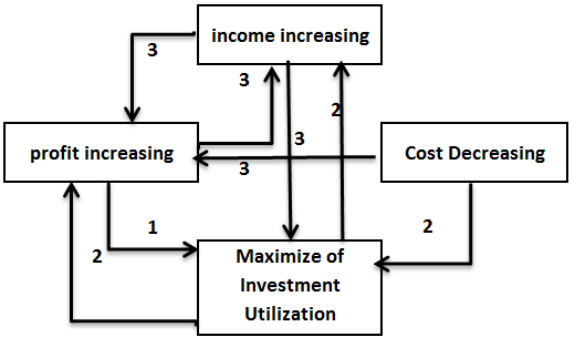

Fig.2. the relationships in BSC Financial Perspective

In this section, DEMATEL technique and total relationships strategic matrix are used to priority of BSC perspectives; important factors for each

perspective are established in Tables 2 to Table 6. Also priority of strategy mapping is determined as result.

According to results that are acquired by planning a data collection of $(D_k + R_k, D_k - R_k)$; the relationships among BSC perspectives for strategy mapping in system performance are demonstrated in Fig 6.

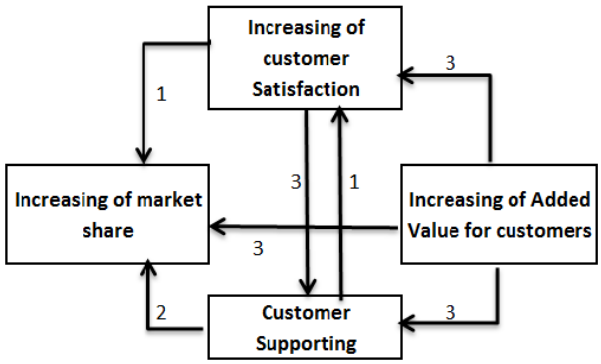

Fig.3. the relationships in BSC Customer Perspective

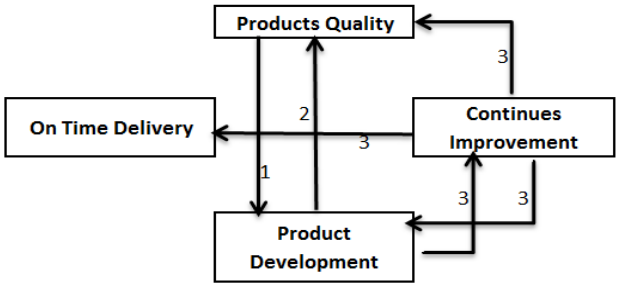

Fig.4. The relationships in BSC Internal Factors perspective

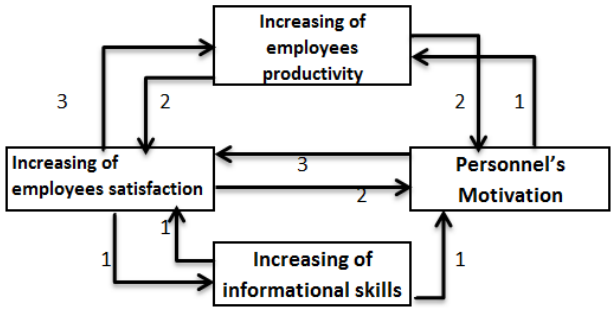

Fig.5. the relationships in BSC Learning and Growth perspective

Conclusion

We have proposed a conceptual model which is the first practical map for management decision making. Fig. 6 indicates that customer perspective is the most important approach in organization and needs more attention by managers.

Table 2. Total relationships matrices for BSC perspectives

	F	C	IF	LG	D	D+R	D-R
F	0.188	0.176	0.218	0.191	0.773	3.004	-1.458
C	0.699	0.251	0.311	0.273	1.534	3.216	-0.148
IF	0.467	0.563	0.164	0.144	1.338	2.421	0.255
LG	0.877	0.692	0.39	0.22	2.179	3.007	1.351
R	2.231	1.682	1.083	0.828			

Table 3. Financial perspective total relationships matrices

	II	PI	MIU	CD	D	D+R	D-R
II	1.25	1.58	1.35	0	4.18	8.97	-0.61
PI	1.32	0.99	0.98	0	3.29	8.422	-1.842
MIU	1.17	1.178	0.78	0	3.128	7.298	-1.042
CD	1.05	1.384	1.06	0	3.494	3.494	3.494
R	4.79	5.132	4.17	0			

Table 3. Financial perspective total relationships matrices

	II	PI	MIU	CD	D	D+R	D-R
II	1.25	1.58	1.35	0	4.18	8.97	-0.61
PI	1.32	0.99	0.98	0	3.29	8.422	-1.842
MIU	1.17	1.178	0.78	0	3.128	7.298	-1.042
CD	1.05	1.384	1.06	0	3.494	3.494	3.494
R	4.79	5.132	4.17	0			

Table 5. Internal perspective total relations matrixes

	OTD	PD	PQ	CI	D	D+R	D-R
OTD	0.127	0.169	0.384	0.386	1.066	2.354	-0.222
PD	0.14	0.129	0.042	0.042	0.353	1.805	-1.099
PQ	0.377	0.428	0.471	0.141	1.417	3.211	-0.377
CI	0.644	0.726	0.897	0.569	2.836	3.974	1.698
R	1.288	1.452	1.794	1.138			

Table 6. Learning & growth perspective total relations matrixes

	IES	IEP	PM	IIs	D	D+R	D-R
IES	1.01	1.195	1.116	0.341	3.662	7.453	-0.129
IEP	1.054	0.686	0.935	0.179	2.854	5.972	-0.264
PM	1.184	0.884	0.717	0.201	2.986	6.236	-0.264
IIS	0.543	0.353	0.482	0.092	1.47	2.283	0.657
R	3.791	3.118	3.25	0.813			

As followed Learning and Growth is the second important strategy and both of them are fundamental features of BSC. In addition, the visual evaluation criteria are divided into cause and effect

group based on Table 2. Cause group including Learning and Growth and also Internal Factors as well as effect group contains Financial and Customer perspectives.

It is essential that company must pay much attention and control cause group due to reach a high level of performance in effect group strategy. According to the Table 2, Learning and Growth is the most important and effective criteria within the cause group. In contrast, within the effect group Customer is the most important and Financial is the most effective factor. By considering Table 2 to 6 for each criteria we can find that Income Increasing and Profit Increasing in Financial perspective, Increasing of market Share in Customer perspective, Continues Improvement and Product Development in Internal Factors perspective and finally Increasing of Employees Satisfaction and both.

Increasing of Employees Productivity and Personal's Motivation in Learning and Growth are respectively the most important and the most effective factors in each perspective.

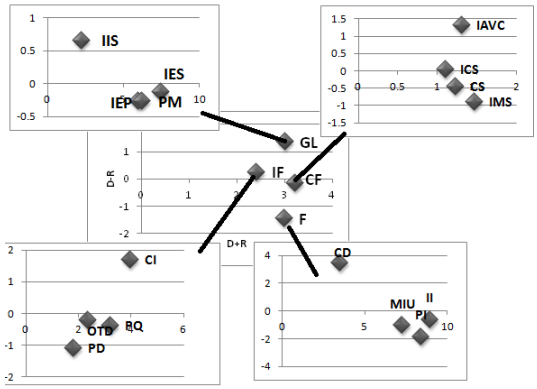

Fig. 6. The cause & effect relationships

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