A New Method for Evaluating and Ranking Performance in Production Plants Based on BSC and MADM Techniques

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ABSTRACT

The main reason of this research is to offering a new method for evaluating performance in production industries . Some Yazd wearing plants were selected as sample and the method based on BSC system and MADM technique was implemented in them. These 5 large plants were chosen in order to do this investigation after holding some consecutive meeting with managers and related experts. BSC system was introduced to them and all key performance indicators has been determined in every 4 aspects of BSC by interviewing and giving some questionnaires to all staffs and accordingly the comparative importance of each and every one was defined. Thereafter all useful data was gathered from all five plants. The plants senior management would benefit by knowing which indexes should be considered when evaluating performance in their plants.

Keywords: *Performance appraisal, production plants, BSC, MADM, TOPSIS*

1) INTRODUCTION

In nowadays competitive world, survival and success of each and every organization is depended directly to proper competitive policy makings. So, all firms and organizations have to use some new managerial approach inevitably. The main importance of these approaches was the using of KPIs which is playing import role for performance improvement (Neon, 2001).

All traditional performance evaluation systems which were based on financial criteria are not suitable for contemporary business environments anymore. Specially that the importance of organizations' intellectual properties is radically increasing in comparison with tangible properties in terms of achieving competitive advantages. In the other words, 75% of total properties of each organization are included of intellectual properties. As mentioned before these kinds of properties are not noticed by traditional ways of performance evaluation. The only reason and secret of success of new organizations is investment and management of intellectual properties (Kaplan and Norton, 1992).

The Balance Score Card (BSC) system is one of the newest tools for evaluating the performance in today competitive and unsteady world. BSC is a frame work for describing all organizations activities based on 4 aspects: 1- financial 2- customer 3- internal business processes 4- growth and learning BSC is translating the organizations' visions and strategy into 4 solid complexes of criteria which are 1- financial 2- customer 3- inbound organization processes 4- growth (Kaplan and Norton, 1992).

One of the remarkable traits of this method is the value-creation role on intellectual properties. Since the dependency of organizations on their intellectual properties is increasing day by day, BSC, are going to be the main tool for management control.

BSC is used in this project to evaluate the performance of Yazd weaving firms.
Firstly the concept of performance evaluation and BSC method is introduced accordingly. Then the TOPSIS is described as one of the multi-criteria decision-making techniques. Methodology will be studied as the next topic and finally all results is going to be discussed and investigated.

2) PERFORMANCE EVALUATION

This method is to evaluate all activities which are related to all certain objective of organization. (Rose, 1995)
Performance evaluation is a couple of actions and information which is utilized in order to increase the level of the optimum usage of facilities and sources for achieving all goals of organization in the most economical way together with efficiency and effectiveness Whereas basically performance evaluation especially for the way of using sources, is expressed in terms of efficiency. On the other hand, Performance evaluation generally depicts the effectiveness in the organizational aspects. Effectiveness means that the rate of goal attainment by having efficient activities and processes. Actually performance evaluation is quantitative effectiveness and efficiency.

Performance is one of the fundamental concepts of management, since most of managerial tasks are formed on the basis of that, to put differently, the successfulness of each organization is closely depended on their activities. In fact, performance covers all organizational requirements for achieving their defined objectives .So based on what has been explained above, the performances of each and every organization must be unique. Previously, performance was conceived as efficiency but this concept has been altered since 1950s which is indicated briefly in below table.

Table 1: variation of performances concept

After 2000	90's	80's	70's	60's	50's
Efficiency	Efficiency	Efficiency	Efficiency	Efficiency	Efficiency
Effectiveness	Effectiveness	Effectiveness	Effectiveness	Effectiveness	
Productivity	Productivity	Productivity	Productivity		
Flexibility	Flexibility	Flexibility			
Innovation	Innovation				
Continuous Improvement					

Generally the performance evaluation system can be defined as the process of appraisal and measurement and comparison between the way of goal achievement and the rate of attaining appropriate situation. Actually it is an economical estimate of different activities within an organization. In this line, performance evaluation is preventive and recognizing as well. Actually it points out those spots of organization which are required to be improved and take some correction measures whenever the situation is going to be worse. In case of acquiring good results, all facilities and required tools would be used to improve it as maximum as possible.

1-2 Tthe Importance of Performance Evaluation

Once you are able to evaluate of what you are talking about and show them in terms of figures and digits, actually you can claim that you are knowledgeable about that issue but when you are not able to do so, it means that you are less informed about that subject so undoubtedly it is highly annoying.

The ultimate objective of a system is performance appraisal and accordingly improvement of organizational performance level. This method is really important since it monitors the system and shows the way of using organization strategies more practically.

Kaplan & Norton are strongly hold this belief that what you measure is what you achieve and if you are able to measure something you will certainly able to manage it.

A proper performance evaluation system can accompany an organization in achieving its goal in 5 ways:

1. Specifying the current situation of organization
2. Informing others about the destination and direction of organization.
3. Motivation and stimulation of all ploys in the most important key zones of organization
4. Facilitating the learning process
5. Influencing our work behavior

2-2 Performance Evaluation Chronology

Although performance evaluation is an activity which is twisted with the formation of social life of human kind. But the organizational and individual utilization of it has become common and general in 1800 by Robert Oven in weaving industry of Scotland.

Tabe2. Difference of two new and tradition at viewpoints regarding performance evaluation

Traditional Approach	New Approach	Characteristics
Dedicated to Judgment	Dedicated to Growth & Development	General Approach
Judgment and Performance Measurement	Consulter and performance facilitator	Role of evaluator
Past	Future	Evaluation period
Control The Evaluated	Growth, instruct and the develop the evaluated	Evaluation main objective
Organization and top manager's Points of view	Self standardization	Evaluation Standards
Performance control	Performance Growth, Development and Improvement	System Output
Identifying the Successful managers and arrange for financial compensation	Consulting in order to Performance Improvement	Evaluation Results
Imperative	Discussion	Interview Styles after evaluation

2-3 Performance evaluation models

Some of the different models of performance evaluation systems can be counted as follow:

Malcolm quality award model, European institution of quality management , the Deming award, the model of beneficiary analysis, the result and determinant model, the services triangle model, the business processes model, Sink model , the pyramid of performance , the matrix of performance measurement, the theory of limitation, the balance score card model.

3-BALANCE SCORE CARD (BSC)

This method evaluates the level of organizational performance from 4 points of view such as financial, customer, the internal processes of business and growth & learning. By this tool the managers are provided with a comprehensive tool in which the organizations vision and strategy is converted into a solid complex of performance indicators.

BSC is able to convert the mission and strategy into objectives and some indicators which has been organized into 4 different points of view. As mentioned before these 4 points of view are known as financial aspect, customer aspect, internal process aspect and growth and learning aspect. As explained above we can say that BSC is a common language for transmit the concepts, missions and strategies.

BSC is providing us with a method to make all business activities parallel with strategy and performance evaluation and strategic goals as well.

This balance score card method helps organization to overcome their two important key issues:
1) Organizational performance evaluation
2) Implementation of strategy.

In 1999, there was an article in fortune magazine which claimed that the 40% of top executive managers' setbacks was due to their weakness in implementing the strategy not in their weak strategies. Now the question is that why the efficient implementation of strategies is that much difficult and demanding? There is a research which demonstrates that there are several obstacles on the way when we start to carry out strategy.

Aspects of BSCs
Four aspects are considered in BSC:
- Financial aspect: this aspect emphasize on how the strategy and the way of its implementation can affect the ultimate development of a business unit.
- Customer aspect: in this aspect, managers determine all customer classification and market segmentation in which they have to compete with their rival and also they are required to evaluate their own organization performance level. Basically this point of view includes some main criteria for strategic positive achievement. Actually we meant by customer satisfaction, new requirement of customers, customer profitability and market share when we talk about positive achievement.
- Aspect of internal business process: the main duly of managers in this zone is to determine all important internal processes in which the organization is supposed to exert improvement and development in those territories.

 These processes empower the business unit in below portions:
Presenting valuable ideas for customer attraction and retention. To satisfy the shareholders in achieving their eye-catching financial targets.

Internal criteria generally are focused on those groups of internal processes that have the significant effect on customer satisfaction and long-term financial aims. The goals of internal business process, commonly prioritizes those processes and they are able to grantee the future success of the organization.

- Learning and growth aspects: It's known as a fundamental measure for a sustainable growth in the organization.

It's important to take notice on previous aspects which are important factors for present and future success, but it's to note that they are not sufficient themselves. Global competition implicates that all companies should think about their ongoing ability development. And also they are supposed to make value and benefit for their customers and beneficiaries.

4 TOPSIS
TOPSIS is one of the multi criteria decision making systems which are really useful for varieties of problem solving. This method was initially introduced by (huan,yoon) in 1981 and by the time passed by, some modifications have been carried out on it and made it one of the best way of multi indicators decision making system in the world. In this method m choices are evaluated by n indicators and every equation could be considered as a numeral system including m points in an n dimensions space. We suppose that the advantages of each indicator are steadily ascending or descending. The right choice should have the minimum distance to

positive ideals and also the maximum distance to negative ideals. This technique is designed in that way enabling the decision-maker to define the indicators in term of positiveness and negativeness and also decide about the weight and the degree of importance of each indicator in the model.

The steps of using TOPSIS are counted as below:

1-   making the matrix of decision

2-   the decision making matrix is converted into a matrix by using below formula:

$$n_{ij} = \frac{r_{ij}}{\sqrt{\sum_{i=1}^{m} r_{ij}^2}}$$

3-   the weightyMatrix is calculated with below formula: $V = N_D \times W_{n \times n}$

4-   the solution for positive ideal and negative ideal is specified as below:

$$A^+ = \left\{ (Max_i \quad V_{ij} \mid j \in J^+), (Min \; V_{ij_i} \mid j \in J^-) \mid i = 1,2,...,m \right\}$$

$$A^- = \left\{ (Min_i \quad V_{ij} \mid j \in J^+), (Max \; V_{ij_i} \mid j \in J^-) \mid i = 1,2,...,m \right\}$$

5-   the distance of I to ideals is calculated with Oglidos method as below:

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

6-   the relative proximity or intimacy of each indication on the ideal indicator is calculated as below:

$$C_{i+} = \frac{d_{i-}}{(d_{i+} + d_{i-})} \quad 0 \leq C_{i+} \leq 1$$

5- METHODOLOGY

This research is applicable from goal point of view. The main variables are key performance indicators and every steps of doing this research would be shown and discussed as follows:

Phase 1: by interviewing and have some meeting with top managers of all weaving plants, main and strategic goals and strategy plan was yielded. So by putting all information in on pot. A comprehensive and common strategic plan compatible with all plants was resulted.

Phase 2: after delineation of strategic plan and determining the main strategic plan of all firms. A list of organization performance indicators which were Applicable in weaving industry were handed over to managers and elites and they were requested to fill all of lists based on strategic plan, implications and all requirements which are related to weaving industry. So the first 60 indicators was refined and reduced into 34indicators.

Phase 3: for choosing suitable specification of indicators, we have taken advantages of viewpoints of 6 university teachers.

Table 3 Decision making matrix based on specification

Ability to work Optimal	Simplicity and the appearances	Reality reflection to the personal Ideas	Present the concise and precise Information	Controlling the Personnel	Information Accessibility	Focus on PDCA	Visibility of the Effects	Precise and timely Feedback	Easy understandable and applicable	Strategic Goals convergence	People Characteristics
7	5	7	1	5	6	1	5	7	7	9	1st Person
2	2	5	4	6	7	5	7	7	5	7	2nd Person
7	5	8	8	5	6	4	3	3	7	9	3rd Person
7	5	9	9	5	9	7	7	7	5	9	4th Person
4	6	8	7	2	7	7	8	9	7	8	5th Person
1	2	7	3	5	9	3	8	5	9	8	6th Person

According to the results achieved by TOPSIS model.4 traits which their intimacies to ideals were closer to each other were chosen. Although having some direction with targets had a remarkable weight and no need to say that it was confirmed by all teachers.

If we want to rank the selected characters in consideration of intimacy to IDEAL, it could be counted as follow respectively: being in as come direction as strategic goals, reality reflection not individual point of view, data accessibility, easy perception and utilization.

Table 4: normalized weighed characters.

Normalized Weight	Cl+	Indicators' Characteristics	ردیف
0.284	0.937	Strategic Goals convergence	1
0.247	0.817	Reality Reflection	2
0.240	0.792	Data Accessibility	3
0.229	0.758	Simplicity of perception and utilization	4
1	3.304	Sub Total	

Phase 4: in this phase we compare all indicators which were confirmed by managers against all 4 chosen characters. So provide managers and exports with a particular questionnaire including a table in which rows indicate KPIs and columns show good characters. Accordingly they are asked to give points between 1 to 10 to them. Once we gathered all questionnaire, by using TOPSIS method we figured out that 14 indicators which their intimacy were more than 85% could be chosen as our KIPIs. These indicators could cover all strategic goals of organization; you can find all KPIs and their relative intimacy as below table:

Table 5: the chosen KPIs and their intimacy ratio

Relative Intimacy Cl	Indicators	منظرهای BSC
0.937	1-Dividend	Financial Point of view
0.877	2- Value added	
0.975	3- The percentage of Customer Retention	Customer Point of view
0.869	4- The percentage of Timely Delivery	
0.886	5- The average of Delivery time to Customer	
0.878	6- Inventory Turn Over	Internal process Point of view
0.886	7- The Percentage of Loss	
0.945	8- The average production time for each Product	
0.921	9- The percentage of total production against the capacity	
0.915	10- The percentage of Total Idle days	
0.899	11- Education Investment	Growth and Learning Point of view
0.886	12- The Quality of Work Environment	
0.89	13- % Of staff absence	
0.891	14- Percentage of employee satisfaction	

Phase 5: in this step we conducted another assessment by handing over some extra questionnaire to managers and expert, therefore as a result we could find out the importance of each aspect of BSC together with their relevant indicators separately and individually.

According to that assessment you can find the result as below
-financial aspect: 40%
-customer aspect: 50%
-internal process of business: 17%
-learning & growth aspect: 13%

-above study was conducted in 5 big and prominent weaving plants: Naghshin plant, Salkbaf, Yazdbaf, Afshar, Nassaji Ardakan.
- It should be heeded that all data were extracted from these 5 pants between Tir 1389 till Dey 1389

6- CASE STUDY AND THE RESULT
For carving out this research 5 big and prominent plants of Yazd were selected.
The final ranking of respective plant based on chosen KIPs of BSC is indicated as follow:
1-D
2-B
3-A
4-E
5-C
Also if we want to extend the result in detail, we can make the ranking based on 4 aspects as below
-          Ranking based on financial aspect: 1-D , 2-B , 3-A , 4-C, 5-E
-          Ranking based on customer aspect:
-          Ranking based on internal process aspect:
-          Ranking based on learning & growth aspect:

With regards the achieved result it seems that one at the thematic problem in this industry is not paying sufficient attention and suitable investment on learning and growth aspect. It's obvious that by paying attention to work force and their requirement and also improving their knowledge and ability, lots of problems can be obviated spontaneously. No need to say that all financial problems will be solved subsequently.

7 CONCLUSION

Since industry section is one of the fundamental and important infrastructures of every society. The more we pay attention on this section the more our society grows up in consideration of financial issues. And since the is no way for every system and organization to be improved with out performances evaluation, so industry selection is also required to have a total performance evaluation system. There are lots of difficulties in evaluating the performance of industries within the county. Some of them are:

-unavailability of comprehensive evaluation criteria

-not prioritizing the evaluation criteria

- paying too much attention to short term performance instead of long term value making

- Inability of chosen criteria to reflect strategic goals completely.

- It's not a big deal for those companies which don't have financial problem to have a performance evaluation system.

Applying BSC model and MADM technique are able to resolve these problem some deal. We have tried to present an appropriate model for performance evaluation and raking Yazd wearing industries by combination of both BSC and MAMD models.

Since Yazd province is one of the big and influencing pole in wearing company these years, lots of people has been employed by this industry. But this industry has been involved with some fluctuation within couple of recent years and still lots of private and small industries are working with a lot of financial issues which has caused factory to cut off their manpower. In this research the weaving industry has been considered and monitored as a statistical sample with this hope that the initial root and reasons of these problems would be found.

As explained before in this article, we have investigated the BSC method and it's usage in performance evaluation of Yazd weaving industry. So firstly we introduced the concept of performances evaluation and then BSC and finally TOPSIS technique were taken into consideration and according the research method was discussed in details .the main reason of problems in this industry was identified by using BSC method. So by conducting this research a combination of KPIs were introduced on the basis of four aspects (financial, customer, internal processes and learning and growth). Afterwards we have talked about the importance of each one and they were determined by the ideas of managers and other technician. And it was concluded finally by ranking the firms and plants.

Based on ranking results. It was conceived that by disregarding the learning and growth aspects and by not having a good and timely planning procedure for increasing the ability of workers and their job satisfaction you will confronted witch financial issues, but by making good policies and also proper planning. We can obviate most of these difficulties in the best way. This will be accompanied with good financial results the point is that, people who are working in weaving industry don't pay attention to above underlying problem and their proper solution.

While we were working on this research we faced with lost of difficulties such as inaccessibility to a data base for calculating the indicators and also unavailability of information and this should be emphasized that we had lots of problem in dealing with some managers based on what we have acquired and also with regards to sincere cooperation of some managers, it's recommended that we use BSC as a guideline managerial System in addition to performance evaluation in our next researches.

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