Full Length Research Paper

Designing an organization assessment model based on European foundation for quality management using multiple criteria decision making

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European foundation for quality management (EFQM) excellence model has been suggested by 14 European companies in 1988. It has been several years that this model has also been used by Iranian industry officials namely, ministry of the industry of the Islamic Republic of Iran to recognize and solve the problems of Iranian organization. In this model, evaluating is done by qualitative variables but there are some criticisms to this model firstly, qualitative variables cannot be scored by numbers secondly, EFQM model is only an assessing activity but does not offer any improving plan afterwards. This paper suggests that for removing these criticisms that scoring must be done from areas to address and final assessment must be done by the evidential reasoning approach. Improvable areas must be recognized after finalizing assessment and must be classified into two major groups; simple and significant. Significant improvable areas must be prioritized and then put into action in order to organization reach to higher excellence during next years. The consequences of research show that although, the weight of sub-criteria and areas to address are equal in the model, however, it is not equal.

Key words: European foundation for quality management, multiple criteria decision making, TQM, Assessment, excellence model.

INTRODUCTION

Nowadays many of Iranian economical agencies have been faced with many different challenges regarding globalization. Globalization of economy and impressive changes in international markers has made competitive activities for agencies and made it complicated. Changes to dominant factors over business environment inside the country, which is mostly unpredictable, has made the issue more complicated and harder. In this regard European foundation for quality management (EFQM) is a powerful tool to help organization in order to confront with these challenges and changes. Recently there has been increasing interests over organizations regarding to self-assessment and to know their strategies, they use model EFQM (Ahmed et al., 2003). Nowadays excellence model have been used vastly by organizations and many

European countries are offering their quality national award on the base of excellence models (Wongrassamee et al., 2003). EFQM is used to assess performance of an organization. This model contains two major parts, namely: Enables and Results. Five criteria of Enablers are:

1. Leadership
2. Policy and strategy
3. People
4. Partnership and resources
5. Processes and

Four criteria of Results are:

1. People results
2. Customer results
3. Society results
4. Key performance results.

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Each sub-criterion consists of some areas to address on its own. The assessment method in the model is as follows: Assessors score each sub-criterion as semi metric or 0-100 in the elements of "approach", "deployment" and "assess and review".

1. Approach: It refers to goals which are related to each criterion.
2. Deployment: It is applicable of approach.
3. Assess and Review: It refers to measurement and learning of organization (EFQM, 2003).

There are some criticisms to method of scoring in EFQM which is mentioned briefly in this paper. Measurement of qualitative variables are subjective and imprecise (Li and Yang, 2003). Scoring in EFQM model has some weaknesses and can be removed by Data Envelopment Analysis (Donnelly, 2008) . Sometimes scores in enables are not proportionate with results (Langroudi et al., 2008). EFQM never offers any improvement plan (Nazemi, 2008). With respect to the above criticisms, it can be implies that the assessors in the model EFQM should be ready to confront with objection of evaluated organization So, the question is how we can amend EFQM in order to decrease or remove criticisms. This paper will offer a methodology using multiple criteria decision making (MCDM) to respond to the mentioned questions. Totally MCDM method is divided into two major groups:

1. Multiple Objective Decisions Making (MODM): In this decision making method, several goals is optimized simultaneously. Measurement scale of each goal might be different from others. For example, one goal is to maximize the profit which measures in monetary scale. Other goal is to minimize the working time unit which measures is hours.

2. Multiple Attribute Decision Making (MADM): The goal in this model is to choose an alternative among other ones. There are different problems of MADM consists of common specifications as follows:

(a) Alternatives: in each problem of MADM there are some alternatives which must be prioritized or chosen or ranking. For example, choosing a car among others.
(b) Multiple indexes: each MADM has several indexes must be chosen by decision maker. For example, price, types of guaranty and fuel consumption.
(c) Normalization: each index has different measurement norms than other ones therefore, must be normalized such that to keep relative importance of data.
(d) Weight of indexes: all methods of MADM need some weights which obtain from relative importance of each index or these weights of indexes are decided by decision maker directly.

Multiple attribute decision making methods

There are two types of MADM method, first one is

Non-compensatory and the other is compensatory:

1. Non-compensatory methods: These methods do not permit tradeoff between attributes. An unfavorable value in one attribute can not be offset by a favorable value in other attributes. Each attribute must stand on its own. Examples of these methods include: Dominance method, Eliminate method, Maxmin method, Minmax method, Lexicography method, Satisfying method, Conjunctive method and Dejuctive method.
2. Compensatory methods: These methods permit tradeoff between attributes. A slight decline in one attribute is acceptable if it is compensated by some enhancement in one or more other attributes. Compensatory methods can be classified into the following four sub-groups:

(a) Scoring methods: These methods select an alternative according to its score. Score is used to express the decision maker's preference. A very popular method in this category is the simple additive weighting method. The Analytical Hierarchy Process (AHP) is another popular method in this category. This method calculates the scores for each alternative based on pair wise comparison matrix (Saaty, 1990).
(b) Compromising methods: These methods select an alternative that is closest to the ideal solution. A very popular method in this category is the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). The TOPSIS selects an alternative that is closest to the ideal solution. This method first normalizes the decision matrix of a MADM problem. Then, based on the normalized decision matrix it calculates the weighted distances of each alternative from an ideal solution and a nadir solution. A solution relatively close to the ideal solution and far from the nadir solution is evaluated to be the best (Hwang and Yoon, 1981).
(c) Concordance methods: These methods generates a preference ranking which best satisfies a given concordance measure. The Linear Assignment method is one of the examples in this family. In this method it is believed that an alternative having many highly ranked attributes should be ranked higher (Hwang and Yoon, 1981).
(d) Evidential reasoning approach: The evidential reasoning approach is the latest development in the MCDM area. It is different from the above 3 conventional methods. Instead of describing a MCDM problem with decision matrix, the ER approach uses an extended decision matrix, in which each attribute of an alternative is described by a distributed assessment using a belief structure. For example, the distributed assessment result of the quality of car engine could be (Excellent, 60%), (Good, 40%), (Average, 0%), (Poor, 0%), (Worst, 0%), which means the quality of the car engine is assessed to be excellent with 60% of belief degree and Good with 40% of belief degree. It describes and handles uncertainties by using the concept of the degrees of

belief (Xu and Yang, 2001).

LITERATURE REVIEW

In 1988, fourteen European companies supported by European Union, established European foundation for quality management. At the present more than 800 European companies are members of this organization. Many researches have been done in relation to the model EFQM. Many researches have focused on excellence award model, comparison of their criteria and relation between award winners and their business results (Cole, 1991). However, in this paper we have tried to explain a few researches that have been done in this field:

A research shows that the organizations used excellence awards have had many progress includes, sale, recruitment and assets growth (Hendricks and Singhal, 2000). According to a questionnaire method, researchers asking 756 Danish executive company managers about weights of criteria in EFQM excellence model. The results show that there is a difference between the Danish executive manager's opinions and EFQM model in relation to the weights of the criteria (Eskildsen et al., 2002).

A research denotes that a different factors lead to that method of scoring in EFQM is accompanied with subjective and uncertain (Li and Yang, 2001). This research offers evidential reasoning approach for removing the above criticisms.

Another research shows that EFQM can be used as a useful framework of knowledge management (Martin and Rodriguez, 2008).

A research has been done in a hygienic organization used EFQM, shows a growth of 89% in patients satisfaction (Sanchez et al., 2006).

Another research in Iranian automobile sector confirms the integrity of the EFQM and its link to key performance results (Nazemi, 2008).

METHODOLOGY

This paper has designed methodology to removing and responding to those mentioned criticisms by using MCDM. This methodology uses three steps scoring method, evidential reasoning approach and TOPSIS method.

First step: Vertical development

In this step, EFQM develops vertically. It means that scoring will be done by the area to address instead of scoring by the sub-criteria. So, the weights of sub-criteria and area to address must be calculated by one of the scoring methods. The following process is used to calculate the weights:

-Designing the structure of hierarchy sub-criteria and area to address.
-Preparation of pair wise comparison matrix from sub-criteria and area to address.
-Questionnaire from 30 expert persons in a certain interval scale.

-Calculating geometric mean.
-Merged matrix.
-Calculating inconsistency ratio.
-Normalizing matrix.
-Calculating weighting of sub-criteria and area to address by one of the scoring methods.

Table 1 shows the weights of sub-criteria and area to address for the leadership criteria and inconsistency ratio of tables.

Second step: Scoring and finalizing

assessment *Scoring*

Each of the four assessors by using check lists related to the EFQM, scores areas to address for leadership criteria from 0 – 100 (semi metric). These scores allocate to three elements, approach and deployment and assess and review. Then the average of scores is calculated separately for each element. Table 2 shows the average scores of each element. Calculation of scores of sub-criteria and criteria are obtained through multiplying the scores and their weights respectively, from lower levels to above levels.

Finalizing assessment

Finalizing assessment is done through the evidential reasoning approach. The final assessment is described as degrees of belief instead of being a score. For this reason, assessment grade is needed so, the five degrees of total quality management of Dale and Lascelles is used. These five grades are:

1. Uncommitted
2. Drifters
3. Improvers
4. Award winners
5. Word class.

Scores are distributed between these five grades from 0 - 100. Table 3 shows the relationship between these five grades and linguistic variables. Conversion of scores from 0 - 100 into linguistic variable numbers is done by using trapezoidal fuzzy function. Then, by using belief matrix, the belief grade is obtained (Li and Yang, 2001). Table 4 shows the belief degree of all areas to address of leadership of criteria. These calculations can also be done for sub-criteria and criteria.

Third step: Horizontal development

In this step EFQM will develop horizontally in order to help managers for better planning. So, the following processes must be kept on even after final assessment in order to remove another criticism:

-Definition of goal grade and recognizing improvable areas: In order to recognize improvable areas, goal grade must be select by managers. It is better to choose the grade which has sufficient challenges for improvement through these five mentioned grades. By defining goal grade, all areas to address which are located under the goal grades would be recognized as improvable areas.
-Classifying improvable areas to simple and significant: In order to classify improvable areas to two groups namely simple and significant, two indexes are used:

1. Duration of executing of improving plan.

Table 1. Weights of qualitative variables and inconsistency ratio 6 tables.

	Sub-criteria	Weight	Inconsistency ratio (%)
a	Leaders develop the mission, vision and values	0.3223	
b	Leaders are personally involved in ensuring the organization's	0.2533	
c	Leaders are involved with customers, partners and representatives of society.	0.2093	5
d	Leaders motivate, support and recognize the organization people.	0.1340	
e	Leaders identify and champion organizational change areas to address	0.0811	
a-1	Developing the organization's mission and vision.	0.194	
a-2	Developing and role modeling ethics and values which support the creation	0.1645	
a-3	Reviewing and improving the effectiveness of their own leadership and acting	0.1479	4
a-4	Being personally and actively involved in improvement activities.	0.1254	
a-5	Stimulating and encouraging empowerment, creativity and innovation.	0.1207	
a-6	Encouraging, supporting and acting upon the findings of learning activities.	0.1033	
a-7	Prioritizing improvement activities.	0.0857	
a-8	Stimulating and encouraging collaboration within the organization.	0.0578	
b-1	Aligning the organization's structure.	0.3386	
b-2	Ensuring a system for managing processes is developed and implemented.	0.2555	
b-3	Ensuring the processes for the development, development and updating of policy	0.1837	6
b-4	Ensuring processes for the measurement.	0.1343	
b-5	Ensuring a processes, or processes, for stimulating.	0.0875	
c-1	Meeting, understanding and responding to needs and Expectations.	0.229	
c-2	Establishing and participating in partnership.	0.2072	
c-3	Establishing and participating in joint improvement activity.	0.1949	6
c-4	Recognizing individuals and teams of stakeholders for their contribution	0.1698	
c-5	Participating in professional bodies, conference and seminars.	0.1086	
c-6	Supporting and engaging in activities that aim to improve the	0.0901	
d-1	Personally communicating the organization's mission, vision, values, policy	0.2824	
d-2	Being accessible, actively listening and responding to people	0.2913	
d-3	Helping and supporting people to achieve their plans, objectives.	0.1979	6
d-4	Encouraging and enabling people to participate in improvement activity	0.1481	
d-5	Recognizing both team and individual efforts, at all levels within the organization,	0.079	
e-1	Understand internal and external drivers of change.	0.1626	
e-2	Identifying and selecting change.	0.1608	
e-3	Leading development of change plans.	0.1404	
e-4	Securing investment for change.	0.1048	
e-5	Measuring the delivery and risk of change.	0.103	3
e-6	The effective delivery of change.	0.0978	
e-7	Communicating change.	0.0907	
e-8	Supporting and enabling people to manage change.	0.0806	
e-9	Measuring and reviewing the effectiveness of change programs	0.673	

2. Amount of changes.

Tables 5 and 6 show improvable areas of simple and significant classes.

-Prioritization of significant improvable areas based on MADM: The TOPSIS method has been chosen in order to prioritize significant improvable areas. MADM method needs a decision matrix for prioritizing. A decision matrix consists of alternatives, indexes and scores. In this paper alternatives are significant improvable areas.

Indexes are as follow:

1. Possibility of execution plan
2. People results
3. Costomer results
4. Society results
5. Key performance results but, the scores are utilities which inscale of Saaty interval, the assessors will score to each alternative with respect to indexes. Table 7 shows decision matrix.

Table 2. Mean of scores.

	Areas to address	Approach	Deployment	Assess and Review
a-1	Developing the organization's mission and vision.	56	56	46
a-2	Developing and role modeling ethics and values	66	38	56
a-3	Reviewing and improving the effectiveness of their	58	25	46
a-4	Being personally and actively involved in	52	56	40
a-5	Stimulating and encouraging empowerment,	38	31	16
a-6	Encouraging, supporting and acting upon the	56	53	16
a-7	Prioritizing improvement activities.	61	61	51
a-8	Stimulating and encouraging collaboration	43	38	11
b-1	Aligning the organization's structure.	51	50	21
b-2	Ensuring a system for managing processes is	58	58	58
b-3	Ensuring the processes for the development,	60	58	51
b-4	Ensuring processes for the measurement.	50	46	40
b-5	Ensuring a processes, or processes, for	38	28	31
c-1	Meeting, understanding and responding to	36	28	18
c-2	Establishing and participating in partnership.	33	51	36
c-3	Establishing and participating in joint	37	27	26
c-4	Recognizing individuals and teams of	25	16	13
c-5	Participating in professional bodies,	38	28	17
c-6	Supporting and engaging in activities that	37	40	37
d-1	Personally communicating organization's	66	52	48
d-2	Being accessible, actively listening and	60	50	50
d-3	Helping and supporting people to achieve	56	40	40
d-4	Encouraging and enabling people to	56	43	35
d-5	Recognizing both team and individual efforts, at all levels	48	43	31
e-1	Understand internal and external drivers of	63	62	57
e-2	Identifying and selecting change.	60	60	56
e-3	Leading development of change plans.	50	56	46
e-4	Securing investment for change.	56	56	46
e-5	Measuring the delivery and risk of change.	40	38	30
e-6	The effective delivery of change.	27	18	27
e-7	Communicating change.	38	32	33
e-8	Supporting and enabling people to manage	40	37	30
e-9	Measuring and reviewing the effectiveness	37	18	25

Table 3. Linguistic variables.

Evaluation grades	Uncommitted	Drifters	Improvers	Award winners	Word-class
Utility value	0	0.25	0.05	0.75	1
Approach deployment assess and review	No evidence	Little evidence	Evidence	Extensive evidence	Comprehensive evidence
Score dimension	0	25	50	75	100

-Calculation of weight of indexes: First of all, decision matrix should be normalized then, by using the following formulas, weights are calculated by Shanon Entropy will merge with DM weights. Table 8 shows weights of Shanon Entropy. Table 9 shows weights of decision makers (DM) and Table 10 shows merged weights.

$$P_{ij} = \frac{r_{ij}}{\sum_{i-1}^{n} r_{ij}} , \forall_{i,j} \tag{1}$$

Table 4. Belief percent.

Areas to address	U	D	I	A	W
a-1			1		
a-2		0.08	0.58	0.34	
a-3			1		
a-4			1		
a-5		0.76	0.24		
a-6		0.34	0.66		
a-7		0.2	0.8		
a-8			0.8	0.2	
b-1		0.34	0.66		
b-2			1		
b-3			1		
b-4			1		
b-5		0.75	0.25		
c-1		0.92	0.08		
c-2		0.58	0.42		
c-3		0.58	0.42		
c-4	0.08	0.92			
c-5	0.25	0.75			
c-6		0.33	0.67		
d-1			0.67	0.33	
d-2			1		
d-3			1		
d-4		0.33	0.67		
d-5		0.33	0.67		
e-1			0.58	0.42	
e-2			1		
e-3			1		
e-4			1		
e-5		0.42	0.58		
e-6			1		
e-7		0.75	0.25		
e-8		0.50	0.50		
e-9		0.83	0.17		

$$E_{ij} = -k \sum_{i=1}^{m} \left[P_{ij}.\ln P_{ij} \right], \forall_j \tag{2}$$

$$d_j = 1 - E_j, \forall_j \tag{3}$$

$$w_j = \frac{a_j}{\sum_{i=1}^{n} a_j}, \forall_i \tag{4}$$

$$W_j' = \frac{\lambda_j w_j}{\sum_{j=1}^{n} \lambda_j w_j}, \forall_j \tag{5}$$

-Prioritizing through TOPSIS: The following processes have been done:
-Normalizing decision matrix.
-Calculating of Vn: Normalized matrix multiples in merged weights.

$$V_n = N_D . W_{n*n} \tag{6}$$

-Calculating positive and negative ideal solution.
-Calculating the weighted distances of each alternative from an ideal solution and a nadir solution.
-Calculating relative closeness index of Ai to the ideal solution.

$$A^+ = \left\{ \left[\max v_{ij} \middle| j \in J_1 \right], (\min v_{ij} | j \in J_2) \middle| i = 1,2,...n \right\} \tag{7}$$

$$A^- = \left\{ \left[\min v_{ij} \middle| j \in J_1 \right], (\max v_{ij} | j \in J_2) \middle| i = 1,2,...n \right\} \tag{8}$$

$$A_i^+ = \left\{ v_1^+, v_2^+, ..., v_n^+ \right\} \tag{9}$$

$$A_i^- = \left\{ v_1^-, v_2^-, ..., v_n^- \right\} \tag{10}$$

$$J_1 = \left\{ 1,2,..., n \right\} \ for\ positive \tag{11}$$

$$J_2 = \left\{ 1,2,..., n \right\} \ for\ negative \tag{12}$$

$$d_i^+ = \sum_{j=1}^{n} (v_{ij}^- - v_j^+)^2, (i = 1,2,..., m) \tag{13}$$

$$d_i^- = \sum_{j=1}^{n} (v_{ij}^+ - v_j^-)^2, (i = 1,2,...,m) \tag{14}$$

$$c_i = \frac{d_i^-}{d_i^- + d_i^+} \qquad (i = 1,2,..., n) \tag{15}$$

RESULTS

To assess an organization, EFQM can be used but, scoring activity must be done by the qualitative variables of area to address in order to assess all aspects of each criteria. The weights of sub-criteria and areas to address have been calculated by pair wise comparison matrix. Calculations show that inconsistency ratio of all tables are below 10% so, they are reliable. The consequences of research show that sub-criteria and areas to address have different weights which must be considered by

Table 5. Simple improvable areas.

a-8	Stimulating and encouraging collaboration within the organization.
b-1	Aligning the organization's structure.
b-5	Ensuring a processes, or processes, for stimulating.
c-4	Recognizing individuals and teams of stakeholders for their contribution to the business, for loyalty etc;
c-5	Participating in professional bodies, conference and seminars.
c-6	Supporting and engaging in activities that aims to improve the environment.
d-5	Recognizing both team and individual efforts, at all levels within the organization, in a timely and appropriate manner.
e-4	Securing investment for change.
e-6	The effective delivery of change.
e-7	Communicating change.

Table 6. Significant improvable areas.

a-5	Stimulating and encouraging empowerment, creativity and innovation.
c-1	Meeting, understanding and responding to needs and Expectations.
e-8	Supporting and enabling people to manage change.
e-9	Measuring and reviewing the effectiveness of change programs

Table 7. Decision matrix.

AI	X_1	X_2	X_3	X_4	X_5
A_1	4	4	4	7	7
A_2	7	6	7	9	8
A_3	5	8	5	6	8
A_4	2	4	3	2	7

Table 8. Calculated weights by Shanon entropy.

w I	X_1	X_2	X_3	X_4	X_5
E_j	0.937	0.956	0.963	0.926	0.996
$D_j=1-E_j$	0.63	0.44	0.37	0.74	0.04
W_j	0.283	0.198	0.17	0.34	0.1

Table 9. DM`S weights.

WI	X_1	X_2	X_3	X_4	X_5
w	0.25	0.15	0.15	0.15	0.35

EFQM assessors. Whereas assessment of qualitative variables are uncertain, evidential reasoning approach method must be used to complete the assessment. Recognizing improvable area, goal grade must be chosen and then by using two indexes, duration and amount of changes must be classified to simple and significant. Criteria of EFQM results could be as decision matrix index. Prioritizing of improvable areas show that supporting and enabling people to manage change to achieve higher excellent is situated at higher priority levelrelative to other significant improvable areas.

DISCUSSION

Although, most of the organizations use EFQM for

Table 10. Merged weights.

I	X₁	X₂	X₃	X₄	X₅
W	0.38	0.16	0.14	0.28	0.04

recognizing their problems, but there are many criti-cisms to this model saying that, it is impossible to score a qualitative variable by giving a number also, it does not offer any improvable plan in this model. It seems that these criticisms are acceptable so how we can change or amend the EFQM to convince these criticisms. This paper has offered a three-step methodology to remove the mentioned criticisms by using MCDM. This method has sufficient capacity to resound to mentioned criticisms. In this research Firstly, EFQM has developed vertically in order to assess more qualitative variables. In this case all aspects of each criteria will evaluate directly. This matter causes more improvable areas to be recognized and organization reaches to the higher excellent by their improvement faster. Secondly, scoring is done in normal way of EFQM because, assessors have trained and have sufficient skills to do it but the final assessment is done by evidential reasoning approach. Also, in order that EFQM not only be just an assessing tool but, also could help managers more in planning, it has been developed horizontally. Horizontal development causes remove the criticism which claims EFQM does not offer any planning for improvement. The most important point needs to be considered is determination of the exact goal grade. In this case improvable areas make limited therefore, organization will have sufficient financial and UN financial conditions to improve them. Also, improvable areas will have enough challenges for improvement. Another important point in this step will cause interaction with managers of organization. This interaction is choosing goal grade by top managers and using their opinions as decision makers (DM) in determining index weight of decision matrix which merges with the calculated weight of Shanon Entropy whereas, EFQM does not have any interaction with the managers of organization.

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