An Improved TOPSIS/EFQM Methodology for Evaluating the Performance of Organizations

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Abstract: Studies showed that the scoring system of the EFQM has got some problems that can cause a deviation from the correct assess performance of organization. One of the reasons of this deviation could be due to the scoring approach of EFQM questionnaire. This study is to investigate relationship of each question of the questionnaire with TQM criteria and give a practical way to overcome the existing problem. In this study, with 50 questions of the EFQM and criteria of TQM, a questionnaire has been created. Then, opinions of 175 assessors dealing with EFQM are gathered about the relationship between the questions of EFQM with any of TQM criteria. The data have been processed using SPSS software and the nearest point of a fuzzy number and Topsis model. The results revealed that amount of relationship between each EFQM's question with TQM criteria isn't same therefore the weight of each question in EFQM's questionnaire is not equal to the rest of questions and TQM criteria. Also assigning equal scores to all questions of EFQM's traditional questionnaire is nonrealistic and consequently, the simplicity additive calculation of assessing performance of organization is also nonrealistic and this is created a deviation to assess properly performance of organization. According to the findings of this study, one should consider the EFQM assessors' point of view regarding the relationship between criteria of the two models in order to improve organization performance assessments. Finally, considering the level of priority in Topsis method, a relevant scoring system should be created. This can overcome the problem of deviation in assessing the organization's performance.
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1. Introduction

The European Foundation for Quality Management (EFQM) model of business excellence was introduced in 1992 as a framework for evaluating the performance of organizations competing for the European Quality Award and to recognize organizational excellence in European companies. The model is a non-prescriptive framework that acknowledges the many approaches for achieving sustainable excellence. The framework is based on nine criteria, five of which are *'Enablers'* and four are *'Results'*. (EFQM, 2010). The relationship between these criteria is shown in Figure 1.

In spite of the general acceptance of the EFQM model among academics and practitioners, researchers warn that organizations have encountered problems when trying to measure their overall performance in a bid to identify strengths, as well as areas for improvement and to priorities efforts (Zerafat et al., 2008; Kanji, 2001). Some of the investigators attribute these problems to scoring system of the model and still the scoring criteria are too generally defined. As a consequence, large scoring variations are common, especially with in experienced assessors (Yang et al., 2001; Porter and Tanner, 1996; Siow et al., 2001). Also, in a survey of the British part of a major European project on the use and benefits of self-assessment, Coulambidou and Dale (1995) found that the majority of the companies experienced problems with measurement, including variations in scoring.

Other writers have also identified and criticized the scoring system of the EFQM model and pointed out the following difficulties: Being additive and having a trade-off between the criteria and sub-criteria in final scores calculation, nonrealistic distribution of 1000 scores to criteria and sub-criteria, (Lascelles and Peacock, 1996; Teo and Dale, 1997; Schmidt and Zink, 1998; Borut, 2005; Eskildsen et al., 2001; Kristensen et al., 1998).

Others problems are also attributed to the simplicity of the process involved in computing these performance scores ignore interactions of criteria and sub-criteria, which can lead to wrong score assignments and eventually to a discrepancy in the assessment result (Yang et al., 2001; Siow et al., 2001). However, these difficulties bring about an unrealistic scoring to the criteria and sub-criteria and a deviation to measurement the overall performance of organizations.

Despite the fact that, the EFQM model was launched in 1992; but no researches have been undertaken into the scoring system of EFQM's questionnaire. Therefore, this research had applied multi-criteria decision making (MCDM) in order to overcome equivalent scores and simplicity additive calculation in EFQM's questionnaire.

In MCDM arena, Technique for Order Preference by Similarity to Ideal Solution (Topsis) model has been utilized by researchers because of its several advantages like, using qualitative and quantitative criteria and utilizing different criteria over the other methods (Srdjevici et al., 2004).

Kuo et al., (2012) used failure mode and effects analysis (FMEA) for health care to evaluate the inconvenience of outpatient registration process for elderly patients along with Topsis method to rank the failure risks in the health care. Also Jafarnejad-Chaghooshi et al., (2012) integrated Fuzzy Shannon's Entropy with fuzzy TOPSIS for industrial robotic system selection so that the outcome was ranking and selecting industrial robotic systems. Accordingly, given the difficulties in EFQM scoring system, in this study an assessment has been performed through Topsis model to find the amount of relationship of each question in EFQM in dealing with TQM's fundamental criteria in order to understand each EFQM's question in the questionnaire what amount is able to cover TQM's criteria.

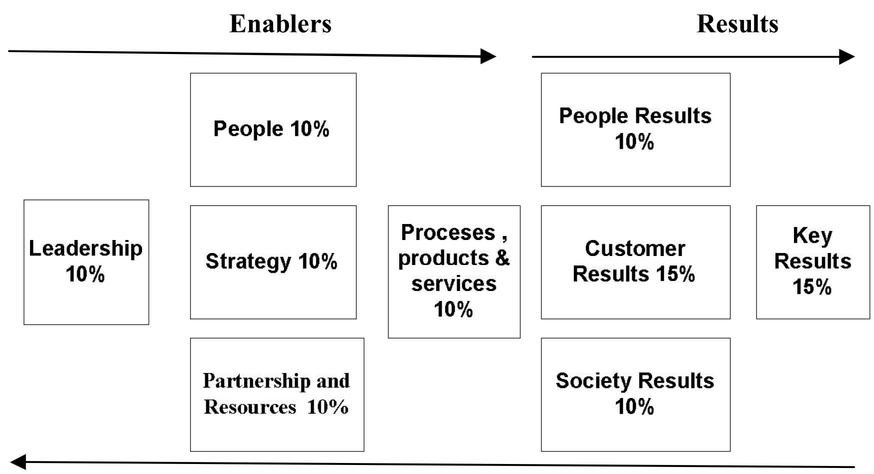

Figure 1. EFQM excellence model, 2010

2. Materials and methods

In order to find a relationship and contribution between the questions in EFQM questionnaire and the eight fundamental concepts of TQM, first, a fifty-question questionnaire according to EFQM's questionnaire and eight fundamental concepts of TQM criteria are prepared without change in its quantity and quality. Then the questionnaire is distributed among 175 EFQM assessors in Iran. There was no need to validate questionnaire, and however, its reliability is confirmed through Test-Retest method. The data collected of this study are analyzed by means of SPSS software and taking geometric mean ($(x_1 \times x_2 \times .... \times x_n)^{1/\sum fi}$) and nearest point of a fuzzy number method [$M(u) = x_0 + \frac{\beta - \alpha}{4}$] (Grzegorzewski, 2002; Asady and Zendehnam, 2007). Then through model and the following algorithm, the importance and the priority of each question in EFQM questionnaire are defined with regard to TQM fundamental criteria.

1- Normalization of decision matrix N

2- Obtaining normalize V matrix ($V = N \times W_{n \times n}$)

3- Defining positive ideal solution and negative ideal one ($v_j^+ \& v_j^-$)

4- Calculating the distance between the positive and negative items

5- Defining the relative closeness of each question with regard to the ideal solution.
6- Ranking of each question (the higher the CL, the better).

The validity of the proposed method has been investigated and verified with EFQM's assessors. Comparing results of the traditional method with the proposed method revealed that the latter is more realistic based of the assessors' opinions. It is also shown that giving unequal scores can cause a better assessment and can reduce deviation of the

$$T_{xn} = \frac{x_n}{\|x_n\|} = \left(t_n^1, \ldots, t_n^k\right) \quad n=1\ldots N \quad ,$$

$$\|x_n\| = \sqrt{\sum_{k=1}^{k} (x_n k)^2} \quad n=1\ldots N$$

Refer to Table of normalized N matrix of the decision matrix (see Table A-1).
2- Calculation of weighting indices:
First step: Calculation of P_{ij} (see Table A-1).

$$P_{ij} = a_{ij} / \sum_{i=1}^{m} a_{ij} \quad ; \quad \forall j$$

py values of E_j

$$E_j = -K \sum_{i=1}^{m} [P_{ij} \, LnP_{ij}] \quad ; \quad \forall j$$

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						E7	E8
						9195	0.709143

$$d_j = 1 - E_j \; ; \quad \forall j$$

						D7	D8
						0805	0.290857

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j} \quad ; \quad \forall j$$

						V7	W8
						3586	0.156627

$$V = N \times W_{n \times n}$$

4- Defining positive ideal solution and negative ideal one.

Negative ideal solution v_j^- = vector of the best values for each index of matrix v
5- Calculating the distance of each item to the positive and negative ideal

The distance of each item to the positive and negative ideal is calculated by the following formula. Negative ideal for positive index is of the minimum value of the V matrix and the negative ideal for negative index is of the maximum value of the V matrix.

$$d_i^+ = \sqrt{\sum_{j=1}^{n} (V_{ij} - V_j^+)^2}$$

$$d_i^- = \sqrt{\sum_{j=1}^{n} (V_{ij} - V_j^-)^2} \quad i = 1,2,\ldots,m$$

6- Determine the relative closeness (CL*) an alternative to ideal solution (The more closely the value to 1, the closer alternative will be to the ideal solution and gives a better solution).

$$CL_I^* = \frac{d_i^-}{d_i^- + d_i^+}$$

7- Ranking of alternatives:
Each alternative (question) having higher score is a better one (see table 4).

Table 4. Ranking of EFQM questions (alternatives) (L, leadership; P, people; S, strategy; P&R, partnership & resources; PPS, processes; product & services; PR, people results; CR, customer results; SR, society results; KR, key results).

EFQM's Questions (alternatives)	CL	rank	CL/sum CL	New score for each question under Topsis method
SR2	0.720359	1	0.061356	61.35646
PPS1	0.617357	2	0.052583	52.58327
L5	0.582949	3	0.049653	49.6526
SR3	0.562961	4	0.04795	47.95004
SR1	0.548407	5	0.04671	46.71046
P&R1	0.525332	6	0.044745	44.74505
L4	0.496526	7	0.042292	42.29152
CR5	0.275066	8	0.023429	23.42867
CR6	0.271996	9	0.023167	23.16717
CR4	0.262259	10	0.022338	22.33784
CR2	0.260577	11	0.022195	22.19461
CR1	0.259771	12	0.022126	22.12594
CR8	0.245945	13	0.020948	20.94833
CR7	0.244387	14	0.020816	20.81565
S1	0.238532	15	0.020317	20.3169
P2	0.223978	16	0.019077	19.07729
PPS3	0.208084	17	0.017723	17.72349
L2	0.201667	18	0.017177	17.1769
PPS2	0.201662	19	0.017176	17.17648
PR1	0.200256	20	0.017057	17.05678
L1	0.200237	21	0.017055	17.05514
CR9	0.198739	22	0.016928	16.92759
P5	0.192877	23	0.016428	16.42824
L3	0.192653	24	0.016409	16.40921
CR3	0.187034	25	0.015931	15.93059
PR5	0.18416	26	0.015686	15.68576
PR2	0.183345	27	0.015616	15.61638
P&R3	0.178974	28	0.015244	15.24408
P&R2	0.178438	29	0.015198	15.19839
KR7	0.175985	30	0.014989	14.98948
PPS5	0.173842	31	0.014807	14.80694
S4	0.172691	32	0.014709	14.70888
PPS6	0.171726	33	0.014627	14.62668
P1	0.161857	34	0.013786	13.78614
PR4	0.160969	35	0.01371	13.71047
PR3	0.159726	36	0.013605	13.60465
P3	0.153582	37	0.013081	13.08135
P&R4	0.146543	38	0.012482	12.48178
KR2	0.141442	39	0.012047	12.04729
P4	0.140946	40	0.012005	12.00503
KR5	0.136264	41	0.011606	11.60629
KR6	0.136049	42	0.011588	11.58795
KR3	0.132406	43	0.011278	11.27766
PPS4	0.129286	44	0.011012	11.01195
S3	0.127426	45	0.010853	10.8535
KR4	0.124978	46	0.010645	10.64498
KR1	0.120568	47	0.010269	10.26938
P&R5	0.104028	48	0.008861	8.860556
S2	0.102383	49	0.00872	8.720488
PPS7	0.023337	50	0.001988	1.987724
Question=50	11.74056		1	1000 scores

The results obtained from putting together Topsis method and EFQM model showed that the question of second Society Results criterion with 61.36 scores is in the first priority. In other words, proper use of social resources and pollution reduction due to organization activities is in the first priority and the first question of Process criterion with 52.85 scores will place in second priority. This emphasizes that in any organization there must be a system in which all activities like production or giving services, must be controlled within the framework of required standards. Moreover, the fifth question about Leadership with 49.65 scores is in third place of priority that emphasizes on the fact that in all levels of managing the organization, there must be suitable activity for receiving more customers and suppliers. The third question of Society Results criterion with 47.95 is in fourth place of priority. This also explains why an organization should find out its level of reputation in community by surveys of public opinion (Table 4).

Moving forward to the third question of Strategy criterion with 10.85 scores is in 45th place of priority and that says all staff activities must be along with the goals of the organization and the staff must be familiar with related programs following these goals in their working section. The forth question of key Results criterion with 10.64 scores is placed in 46th priority and the fifth question of People Results criterion with 8.86 is in 48th place and the second question of Strategy criterion with 8.72 scores is in 49th place and finally, the seventh question of Process, products and services criterion with 1.98 scores is placed in 50th place (the last place), see Table 5.

However, scores in all questions within traditional EFQM's questionnaire approach are equivalent. (The scores of all questions in traditional EFQM's questionnaire approach are: A= 100, B= 67, C= 33, D= 0), (EFQM, 2010).

Therefore, these results show that in EFQM model there is inherently a tradeoff between criteria and sub-criteria by giving identical scores to all 50 questions approach. The problem here is that the weakness of a question is compensated by the strength of another question. This approach, obviously, is a nonrealistic approach. In this situation, one can obviously see a deviation in assessing the performance of organization.

4. Discussion

The results obtained from this study showed that putting together the Topsis method and EFQM model, the result of assessing an organization performance through questionnaire approach is more realistic and more accurate and it prevails seriously over any deviation of the assessment. The outcome of this study that considers all EFQM criteria together compared to other researches considering only one criterion reveals that this is completely a new approach, though there is no study in the past having assessed the approach of the questionnaire itself.

Though some articles have addressed and criticized the scoring system of the EFQM model and some of them even tried to overcome this problem by defining some new methods and ways, there is no instance found regarding the questionnaire approach.

Dodangeh et.al., (2011) believe that given the fact that EFQM is suffering from some weaknesses, so it is not capable of making priority for area for improvement (AFI) in an organization. They, then, introduced a new model using MCDM. Another study revealed that traditional scores introduced by EFQM model couldn't address the real needs of organizations, (Eskildsen et.al, 2002). They analyzed scores through factor scores regression based on confirmatory factor analysis and the results revealed that the dedicated scores to People results criterion in 2001 for the understudies' organizations were far more less than 1998 and 1999. Some of the studies have concentrated on one criterion of the EFQM and they did not consider the model as a whole. For instance, a research in 2003, Li and Yang, assessed only Process criterion and by means of a decision model, they investigated the strong points and the area for improvement. Siow et.al, also,(2001) tried to make a scoring framework in EFQM by using Evidential Reasoning approach (ER), nevertheless the problem of identical scoring still remained in EFQM.

Taking advantage of Topsis model in the present study showed that it is capable to overcome the additive calculation problems. From the methods exist in decision-making area with multiple indexes, Topsis method has been selected in this study because of its advantages over the other methods. The most important advantage of it can be summarized a below:

1) Qualitative and quantitative criteria have been considered all together in assessment process.
2) Considerable criteria are considered.
3) The method can be implied easily and suitable speed.
4) The desirability of the indexes in question is ascending (or descending).
5) Entering data can be altered and assess the change in responding of the system.
6) Making priority in this method is done by similar to ideal-answer logic, in which the selected items should have minimum distance form the best answer and maximum distance from the worst answer.
7) This method considers simultaneously the best answer method and the worst answer method by

considering the closeness to the optimum answer (Srdjevici et al., 2004).

Topsis has been used in number of researches in order to make priority of applied subjects. Ren-Jieh Kuo et.al (2012) used Topsis model with Failure mode and effects analysis (EFMA) in order to reduce the troubles of enrolling the outpatients. Jafarnejad-Chaghooshi et.al (2012) applied Topsis model to rank and select an industrial robotic system and Jozi et.al (2011) to determine the risk priorities in different environments. Ying (2010) combined SWOT and TOPSIS to construct an integration method, using SWOT to build strategic evaluation indicators, and using TOPSIS to evaluate and rank the proposed strategies.

In all studies mentioned above, besides the priority of each question, Topsis provide the analysis on all questions thoroughly. Therefore, given the additive structure in EFQM's questionnaire that trade-off is seriously taken, use of Topsis can overcome the problem of trade-off in criteria and sub-criteria, additive structure in assessing and also get rid of the problems in giving identical scores to the questions of the EFQM questionnaire.

Conclusion

The present study showed that regardless of same scores in the questionnaire of the EFQM model, the nature of the questions has principal difference that it may bring about unrealistic distribution on the scores and provide deviation in assessing the organization. Therefore, this study combined EFQM model with Topsis in order to overcome the existing problems and it introduced a priority system of the questionnaire questions according to the EFQM assessors' opinion. This can show the importance of each question among other questions and can increase the efficiency of the model in assessing performance of the organization by exiting the model from additive calculation and get rid of the trade-off between criteria.

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Appendix:

Table A-1. Normalized N matrix of the decision matrix

TQM Criteria / EFQM Q_S	RO	CF	LCP	MPF	PDI	CLII	PD	CSR
L1	0.2214	0	0.262	0.213	0.17572	0	0	0
L2	0	0	0.296	0.2232	0.1748	0.11621	0	0
L3	0	0	0.267	0.19884	0.1762	0.1379	0	0
L4	0	0	0.2695	0	0.1748	0	0.3188	0
L5	0	0.2577	0.293	0.21196	0.1762	0	0.322	0.2422
S1	0.174	0.2032	0	0.2247	0.1731	0	0	0.2301
S2	0	0	0.16034	0.1491	0	0	0	0
S3	0.176	0	0	0.14851	0.1764	0	0	0
S4	0	0	0.22512	0	0.1744	0.1143	0	0
P&R1	0.1744	0.203	0	0.1321	0	0	0.3194	0.22951
P&R2	0.1572	0.2574	0	0.1465	0	0	0	0
P&R3	0.17422	0.203	0	0.13302	0.1733	0	0	0
P&R4	0	0	0.226	0.13197	0	0.1148	0	0
P&R5	0.1728	0	0	0.15	0	0.15214	0	0
P1	0.171	0	0.15952	0.1336	0.1921	0	0	0
P2	0	0	0.2903	0.1336	0.2521	0.1882	0	0
P3	0	0	0	0.1342	0.25042	0.141	0	0
P4	0	0	0	0	0.2501	0	0	0
P5	0	0	0.209	0.1319	0.2503	0.1424	0	0
PPS1	0.184	0.203	0.209	0.2096	0.161	0.1424	0.3443	0.22733
PPS2	0	0.1604	0	0.2272	0	0	0	0.2339
PPS3	0	0.1381	0	0.2083	0	0.19195	0	0.2297
PPS4	0	0.136	0	0.17312	0	0.1963	0	0
PPS5	0	0	0.2160	0.2329	0	0.2714	0	0
PPS6	0.185	0	0.21252	0.20465	0	0.1977	0	0
PPS7	0	0	0	0.20465	0	0	0	0
CR1	0	0.2622	0	0.1113	0	0.2616	0	0.2577
CR2	0	0.2622	0	0.1026	0	0.2645	0	0.2581
CR3	0	0.2622	0	0.1149	0	0.1944	0	0
CR4	0	0.26	0	0.1025	0	0.2651	0	0.2655
CR5	0.187	0.261	0.224	0.1150	0	0	0	0.2554
CR6	0.245	0.261	0.1641	0.10343	0	0	0	0.2612
CR7	0	0.261	0	0.1138	0	0	0	0.2655
CR8	0	0.26	0	0.10232	0	0.1384	0	0.25496
CR9	0.1865	0.26	0	0.11524	0	0.19395	0	0
SR1	0.1871	0	0	0.10352	0.1618	0	0.3452	0.2554
SR2	0.1791	0	0	0	0	0	0.5821	0.2647
SR3	0.1801	0	0.166	0.1137	0	0.201	0.3407	0.2624
PR1	0.242	0	0	0.10193	0.2567	0.2629	0	0
PR2	0	0	0.1496	0.108131	0.2512	0.1913	0	0
PR3	0.1851	0	0	0.0996	0.2519	0	0	0
PR4	0.1874	0	0	0.1026	0.2539	0	0	0
PR5	0.188	0	0.16103	0	0.2521	0	0	0
KR1	0.2354	0	0	0.0991	0	0.14413	0	0
KR2	0.1894	0	0	0.1079	0	0.2647	0	0
KR3	0.175	0.1602	0	0.0991	0	0	0	0
KR4	0.191	0	0.151	0.10896	0	0	0	0
KR5	0.252	0	0	0.10352	0	0.1913	0	0
KR6	0.1772	0	0.1499	0.1159	0	0.14235	0	0
KR7	0.1786	0	0	0.0968	0.2514	0.1882	0	0