S4-6

MEASURING PERFORMANCE IN EGYPTIAN CONSTRUCTION FIRMS APPLYING QUALITY MANAGEMENT SYSTEMS

Manal S. Abd Elhamid[1], Sahar. Sh. Ghareeb[2] Ramadan O. Mohamed[3]

[1] Associate Professor of Construction Project Management -Housing & Building National Research Center, Cairo,Egypt
[2] Lecturer assistant of Construction Project Management -Housing and Building National Research Center, Cairo, Egypt
[3] Associate Professor of Building Materials-Faculty of Engineering ,Shoubra, Banha University
Correspond to: hamidmanal@yahoo.com

ABSTRACT: The performance measurement of construction firms is considered as a competitive advantage to develop and improve their performance to have place in the market and stay able to face the continuous challenge.
Egyptian construction firms (ECF) started recently to adopt quality management system (QMS) as a way to develop and improve their performance as previous studies showed. However, measuring that performance to include all the firm's aspects in a competitive way is a crucial process for the ECF`s culture. The research is trying to indicate the role of the QMS implementation in measuring performance (MP) through developing a model for measuring performance on the organization level, and explore its impact on the organization that adopt quality management system. This model is based on specific elements and their related indicators which have been derived from national approaches and models of measuring performance (benchmarking, quality awards and six sigma).Elements determination and the status of their real practice has been investigated through a questionnaire to a representative sample of ECF. This model determines the performance level (PL) of the organization that measured by a mean of a point system. Weights of the elements in the point system considered both the elements` importance in the international models and its real practice in the Egyptian construction firms. So, the final outcome of the model reveals the level of firm performance that helps the firm to identify the weak points against the strong ones, Confirm the priorities and identify new opportunities for developing, and Check the position of the company in the market among the others. Another questionnaire has been developed to be distributed on a group of Experts on measuring performance for the purpose of model validation. The majority of surveyed experts agreed that the proposed model can be applied effectively.

Keywords: Measuring Performance; Quality Management Systems; Performance level; Egyptian Construction firms.

1. INTRODUCTION

Nowadays, the construction market has become a global market, which has different customers and many competitors. This environment represents a challenge for the ECF to earn a significant place in that market and more challenge to improve it. Since, it is not possible to manage what cannot be measured, so, adopting a QMS such as ISO 9001, TQM and quality assurance systems; is one of the tools that help to reach that goal and MP is one of the techniques that enable them to manage it effectively. Based on that, the study is exploring the influence of QMS implementation on Performance Measurement in ECF and accordingly developing a model for measuring performance that take into consideration the Egyptian construction culture and the national approaches for measuring performance such as Benchmarking, Quality awards and Six sigma. Definitions and principals of QMS and MP models (MPM) are reviewed for a comprehensive understanding of this relation.

Quality Management System (QMS): In defining QMS, Oakland [1], stated that "a firm organizes itself in such a way that the human, administrative and technical factors affecting quality will be under control, this leads to the requirement for the development and implementation of a quality management system that enables the objectives set out in the quality policy to be accomplished. Abd Elhamid [2] developed a QMS by integration between ISO 9000 and TQM

Performance Measurement in construction: Alarcon and Ashely [3], in their study they explored a variety of PM frameworks that have been implemented in construction since 1990. They proposed the concept of MP, which was classified into cost, schedule, value, and effectiveness. On the other hand, Eccles [4] had pointed out the limitation of business performance measurement using only financial indicators. Abdel-Razek [5], defines MP as the natural part of analysis, control, evaluation, and management process. National models for QMS[2]and different approaches for identifying performance measures have been reviewed to come out with the most common and critical elements of measurements [1], [6] and their related indicators [7], [8]. From these approaches the study concluded and tabulated the most common ten elements in MP and their indicators.

2. METHODOLOGY

To achieve the research objectives; as a preliminarily step a theoretical study took place to get a comprehensive picture about the implemented QMS and MPM locally and globally, and identifying the elements and their indicators for MP. Based on that a field study through surveying by the mean of questionnaires [9] was conducted; a questionnaire has been designed to investigate both the implemented QMS and the applied measuring performance process in ECF, first to investigate the status of measuring performance in construction firms, second to see how it is influenced by the implementation of QMS.

The questionnaire design has passed by many stages:

- Initiative design for format, questions and scale
- Distributing the questionnaire on a pilot sample from seven construction firms; which characterized by good experience and background of total quality and measuring principles in order to positively improve the questionnaire. Piloting was carried out by personal interview.
- Questionnaire adjustments based on the pilot sample feedback

Determination of sample size: The sample size has been determined [10], according to the following equation:

$$n_0 = \frac{z^2\ pq}{e^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where:

n_0 is the sample size .

z is the abscissa of the normal curve for desired confidence level.

e is the desired level of precision .

p is the estimated proportion of an attribute that is present in the population , q is 1-p .

At confidence level 90%, z = 1.64

The desired level of precision is + 10%, so e = 0.1

Assume p = 0.5 (maximum variability), q = 1-p =0.5

$$n_0 = \frac{(1.64)^2\ (0.5)(0.5)}{(0.1)^2} = 68$$

The sample size (n_0) can be adjusted using equation:

$$n_0 = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where, N is the population size =3000 (main construction firms in great Cairo region.).

$$n_0 = \frac{68}{1 + ((68 - 1)/3000)} = 66.5 = 67 \text{ companies}$$

Commonly the calculated sample size is increased by 30~40% to compensate for no response, therefore total number of 140 questionnaires were randomly distributed on Egyptian construction firms in general-whether applying QMS or not-(limited to great Cairo region) [9]. A total of 89 out of 140 questionnaires were returned. 13 of them are rejected and finally 76 questionnaires were ready to be distributed, then analyzed using SPSS computer program.

3. DATA ANALYSIS, RESULTS and DISCUSSION

3.1 Sample profile

Description analysis has been conducted to identify sample profile; Most of the surveyed firms are large in "experience and annual work size". The majority is specialized in execution works (88%), while design and management firms are represented equally in the sample with approximately (47.4%).The private firms have the largest share in the surveyed sample as shown in Fig. 1 which represents the distribution of the firms in the sample with respect to their types.

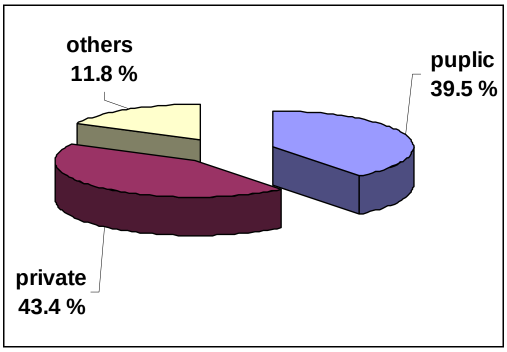

Fig. 1: Distribution of respondents by firm type

3.2 Implemented QMS

The survey has found that ISO 9001 is the most applied QMS in ECFs represents 51.3% of the respondent firms, while just 7.9% of them apply TQM as shown in Fig. 2.

The respondents were asked to choose the level of application of QMS in their firm according to an increasing scale from 'do not apply" to 'apply perfectly".

They were also asked to select the degree of contribution of QMS implementation in improving the performance in their firms as well. Fig. 3 represents the relationship between QMS level of application and its contribution in performance improvement. The Figure shows a positive and approximately linear relationship .The questionnaire also asked about the criteria used by ECF for evaluating the implemented QMS, The respondents were allowed to choose one or more answer. The answers revealed that there are five criteria have exceeded 40% of total responses which are financial measures, coordination between stakeholder, leadership commitment, success in using resources, and customer satisfaction respectively. On the other hand, criteria such that, competition, process management information technology and impact on society have considerably lower percentages.

3.3 correlations between firm characteristics and QMS:

A correlation test using Pearson chi - square statistic; has been conducted to examine if the application of QMS is significantly influenced by the firm

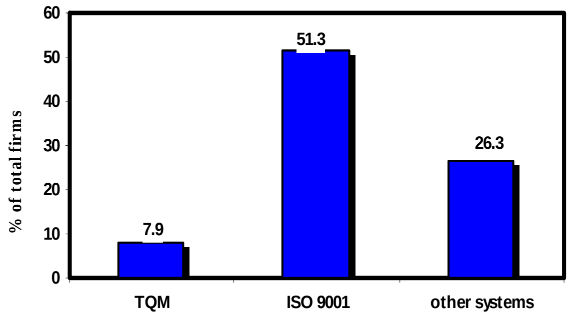

Fig. 2: Implemented QMS in Egyptian construction firms

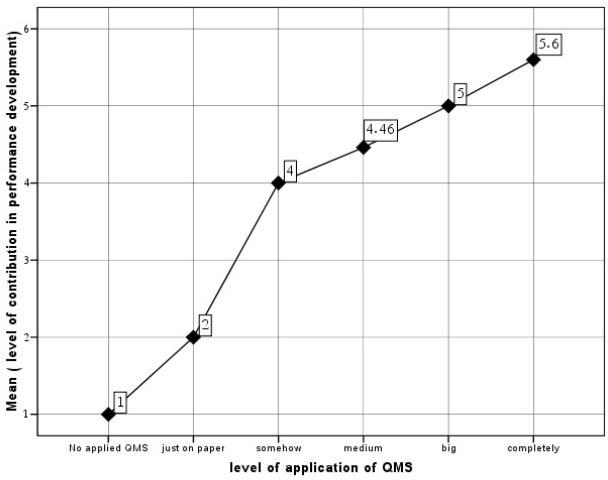

Fig. 3: Relation between QMS implementation and performance improvement.

characteristics, and the results showed that there are high correlation between the applied QMS and the firm type, experience and annual work size, while there is no influence for specialty as shown in Table 1.

Table 1. Correlation between firm characteristics and the applied QMS.

Firm characteristics	pearson chi square for applied (TQM , ISO 9001, their own system)	
	Value	Sig. (2-tailed)
firm type	33.747	0.004*
experience	28.624	0.018*
Type of work(specialty)	45.935	0.803
work size(in million EGY-pound)	35.569	0.017*

*: correlation is significant at 0.05 level

The result assures that QMS are more likely to be applied in private, large and more experience firms.

3.4 The Relative importance of MP elements: The respondents were asked to rank from one to ten a list of measuring elements according to their importance-from their point of view-in the process of MP. Accordingly, the relative importance index (RII) was calculated using the following formula"(3)".

$$RII = \frac{\Sigma P_i U_i}{N\,(n)} \quad \ldots \quad (3)$$

Where:

RII = relative importance index

P_i = respondent's rating (score) which ranges from 1 to 10

U_i= number of respondents placing identical weighting / rating for element

N = total number of respondents

n = the highest attainable score =10

RII of the elements ranking are displayed in table 2.

The analysis of the results in Table 2 reveals that elements that directly related to financial process are weighted as the most important measures. While the elements related to planning and design have less degree of importance and at the last come the elements of training, safety and supplier quality management, which reflect the dominant culture in ECF that care more about the short term targets that directly oriented to quantitative subjective measures.

Table 2. Ranking of elements according to their relative importance

Element	RII	Rank	Degree of importance
Top management and leadership.	0.85	1	very important
Customer satisfaction.	0.84	2	
Productivity and finance.	0.79	3	
Process management.	0.76	4	
Resource management	0.69	5	important
Quality measurement and benchmarking.	0.68	6	
Product design and manufacturing	0.67	7	
employee training and empowerment	0.56	8	less important
Supplier quality management.	0.52	9	
Safety.	0.45	10	

The questionnaire attained the responses from different groups, where the respondents were from public, private and other firms as shown in Fig. (1). Therefore, to determine whether there is a significant degree of agreement among the three groups of respondents regarding the RII of each elements; the Spearman's rank correlation coefficient (ρ) was applied [11]. The Spearman's rank correlation coefficient (ρ) was calculated using equation (4)

$$\rho = \frac{1 - 6\Sigma d^2}{n\,(n^2-1)} \quad \ldots \quad (4)$$

Where:

d = the difference between the ranks given by any two respondents for an individual cause and

n = the number of causes, which in this case is 10 elements

The results are displayed in table (3). The rank correlation coefficients for the elements are: 0.78 for "public and private", 0.76 for "public and others", and 0.96 for "private and others". These indicate a significant degree of agreement between the rankings of different groups of respondents

3.5 Reliability analysis

The reliability of the surveyed data concerning the elements and their related indicators was tested.

Table 3. The relative important index of elements for different groups.

Elements	PUPLIC		PRIVATE		OTHERS	
	RII	rank	RII	rank	RII	rank
top management leadership.	0.852	1	0.840	2	0.842	2
quality measurement and benchmarking.	0.671	5	0.624	7	0.669	7
process management.	0.754	2	0.783	4	0.717	5
Product design and manufacturing.	0.620	8	0.752	5	0.711	6
employee training and empowerment	0.621	7	0.507	9	0.550	9
Safety	0.496	9	0.407	10	0.442	10
Productivity ad finance.	0.752	3	0.811	3	0.817	3
Resource management.	0.664	6	0.661	6	0.738	4
Supplier quality management.	0.465	10	0.535	8	0.583	8
Customer satisfaction	0.748	4	0.876	1	0.931	1

This test is conducted using one of the most common used reliability coefficients Cronbach's alpha ($\propto$)to determine how each item reflects the reliability of the scale by calculating the coefficient alpha after deleting each variable independently from the scale. It was found that ($\propto$) for defining the elements of MP in ECFs is 0.872; indicating that this scale is reasonably reliable. And it is found to be very close to the value based on standardized items. Table (4) shows the average values of $\propto$ if Item deleted, where it can be noticed that most of the elements have values lower than (0.872); referring to their positive effect on the measuring performance.

Table 4. Elements statistics - ($\propto$) if Item deleted

the element	($\propto$)if Item Deleted
Top management leadership.	0.878
Quality measurement and benchmarking.	0.863
Process management.	0.862
Product design and manufacturing.	0.853
employee training and empowerment	0.856
Safety	0.853
Productivity ad finance.	0.863
Resource management.	0.848
Supplier quality management.	0.844
Customer satisfaction	0.875

The previous process of $\propto$ have been applied on the indicators as well, and indicated a reliable scale, and reflects their importance in measuring performance in construction firms.

3.6 The influence of QMS on measuring elements and their indicators:

A correlation test has been conducted to examine if the measured indicators are significantly influenced by the implemented QMS and/or by QMS degree of implementation. The Pearson chi-square statistic has been used to measure the correlation. Results have been summarized in Table 7. By reviewing columns (5) in table 7; it shows that applying QMS has a significant influence on twelve indicators that showed less degree of practice in column 4. And there are fifteen indicators (lined and bold ones) are significantly influenced by the degree of QMS implementation; five out of these belong to the elements "quality measurement and benchmarking" and "Product design and manufacturing". That leads to conclude that adopting QMS enhances MP through qualitative and subjective indicators. Also most of the fifteen indicators have high frequencies in their elements; it means that the more emphasize the firm put in measuring these indicators the higher the level of QMS implementation the firm achieve which reflects a mutual influence between MP process and QMS implementation. It can also be noticed that there is some common indicators (Time required for preparing the project quality plan, Application of quality management systems, Overhead cost reduction, Reduce materials handling, Design quality, and Accidents' frequency) that influenced by both the implementing QMS and their degree of implementation, which reflects the importance of applying QMS for improving the week areas in the ECF`s culture.

3.7 Areas of measuring performance (where to measure?)

The respondents were asked to select their firms` level of measuring performance for areas (human resources, materials, equipments, information and the product) according to scale as shown in table (5).

Table 5. The basic measuring areas in the firm

Degree of measurement / element	frequency						Element weight
	Never (1)	Rarely (2)	Somehow(3)	big extent (4)	Always (5)	Total	
1. Human resources	11	6	**23**	16	20	**76**	3.4
2. Materials	8	2	7	**30**	29	**76**	3.9
3-equipments	7	2	15	**33**	19	**76**	3.7
4 information technology	13	5	**28**	21	9	**76**	3.1
5. product	6	0	5	18	**47**	**76**	4.3

Table 5 reveals that the construction firms in general (whether applying QMS or not) put a great emphasis and control in the areas directly related to money such as (materials, equipments and product), while give less care to human resources and information technology (indirect deal with money).

A cross-tabulation was constructed to measure the correlation between the measuring performance in the basic areas in the construction firms and each of; firm type, specialty, size, experience; applied QMS and its level of application. The Pearson chi-square has been used to measure that correlation. Measures of association are displayed in Table 6.

From the tabulated statistics it can be noticed that:

– The applied QMS has an influence in the degree of measuring all areas except for the materials. That ensures the concluded result earlier according to the respondents' opinions in Figure (5) which shows that the performance improvement is increasing as the level of QMS application increases. Also it is noticed that there are high correlation especially with areas that used to get less care (human resources and information technology), that reveals the role of QMS in improving performance measurements.

– Non surprisingly both the type and work type of the firm are correlated to the degree of measuring performance for the materials and the product, while the degree of measuring performance for the equipment and information technology is influenced by the firm experience.

Table 6. Correlation between the QMS implementation and the basic areas in ECFs

firm characteristic	pearson chi square	The basic areas of construction company				
		human resource	materials	equipment	information technology	product
Company type	value	23.576	32.904	12.08	17.636	21.072
	Approx. Sig.	0.023 *	0.001*	0.439	0.127	0.012 *
Experience	value	17.347	18.384	22.364	29.806	5.304
	Approx Sig.	0.137	0.105	0.034 *	0.003 *	0.807
work type	value	30.469	124.23	32.522	53.954	61.316
	Approx Sig.	0.94	0 *	0.899	0.145	0.002 *
Work size	value	15.368	25.808	12.812	24.665	10.344
	Approx. Sig.	0.498	0.057 **	0.686	0.076 **	0.586
QMS	value	38.064	16.79	29.947	40.826	23.183
	Approx Sig.	0.009 *	0.667	0.071 **	0.004 *	0.08 **
Level of application	value	24.251	23.976	21.644	25.813	18.242
	Approx Sig.	0.232	0.243	0.36	0.172	0.25

* : correlation is significant at 0.05 level

** : correlation is significant at 0.1 level

4. THE PROPOSED MODEL

The concluded relations directed the study to develop a model for MP in ECF. The model is not aimed to be applied at the industry level neither at the project level however it is aimed to be applied at the firm level where the study took place. The purpose of the proposed model is to strengthen the week points in the process of MP to be consistent with total quality management principles. Therefore the model puts more emphasize on continuous improvement, customer satisfaction, human resources in addition to ensures the importance of the measures that financial and market oriented. The model is based on the set of indicators that has been derived from the analysis of the real practices of measuring performance in the Egyptian construction companies.

The model is structured to answer two main questions: first, *what to measure* ,through identifying the measuring performance elements from the international models of QMS and different approaches for identifying performance measures [9], second, *how to measure,* through determining the corresponding indicators from the real practice. The suggested point system has been developed by the integration between the element importance according to the responses' opinions and the real practice for these elements which were determined through respondents' agreements on their indicators implementation in ECFs as shown in Table 7

Following is the mathematical analysis of the model development

1. Calculating the importance level (IL) for each element by dividing the RII for the element by the sum of all indices:

$ILi = RIIi / \sum(RIIi)$ …………………………… (5)

Where:

IL_i = the element`s i importance level (target level)

RII_i = relative important index of element i

i = No. of elements (i=1 to 10)

For example, the element "top management and leadership": $IL_1 = (0.85/6.8)\times 100 = 12.5$ %

2. Determining the percent of real practice (PrJ)for each indicator

Where:

The percent of each indicator = its frequency divided by No. of total response (76 companies.)

And J = No. of indicators (J= 1 to 47)

For example the Pr_J for "planning for change" = (51/76 × 100) = 67.1%).

3. Determining the integrated weight for the indicators (which obtained by integration between the importance level of the element and the real practice of its indicators)

$WcJ = ILi \times PrJ$ ………………………… (6)

Where:

Wc_J = integrated weight for the indicators.

For example the indicator "planning for change"

$Wc_J = (12.5\ \% \times 67.1\%) \times 100 = 8.4$

4. Determining the integrated weight of each element (Wc_i) as the following :

$Wc_i = \sum (Wc_J)$ …………………………………... (7)

For example, the element "Top management and leadership"

$Wc_i = \sum(8.4+6.7+4.3+3.1) = 22.5$

5. Determining the performance level for each element (PL_i)

Where:

$PL_i = Wc_i / \sum Wc_i$ ……………………………. (8)

For example the element "top management and leadership PL_i = 22.5/200 =0.112

6. To obtain a point system that sum up to an integer and to be comparable with the world models of measuring performance the result of each element has been multiplied by (1000). So in the following example for element "top management and leadership"

PLi = 0.112 * 1000 = 112

7. Determining the performance level (PL) for the firm, Where: $PL = \sum PL_i$

4.1 How to apply the suggested model

Column (7) and (8) in table 7 displays the weight of each element and each indicator in the point system of the proposed model. A simple and easy to use excel sheets have been developed to apply the model, shown in Fig. 6. The first monitor in Fig.6 displays scores of indicators that sum up to the scores of elements to sum up in turn to get the PL of the firm. The second monitor determines the firm classification by applying the IF condition, where the value of PL of the construction firm will identify its classification, hence, the study suggested [9] that the firm level of performance to be compared at PL= 600. So the suggested classification for firm performance is:

PL =1000	————	best practice
1000>PL > 600	————	good practice
PL < 600	————	needs improvement

Moreover, the value of performance level for each element is then allocated on the standard radar that displays the weight of each element in the point system as shown in the third monitor for the visual comparison.

4.2. Model verification

The model verification has been accomplished by designing a questionnaire to investigate the opinions of experts in the construction field about the proposed model applicability and practicality in the ECFs. Therefore, the questionnaire is designed [9] with a scale from 1 to 4 (1 the best choice and 4 the worst), then it has been distributed through structured sample of experts (their experience ranges from 17 years to 33 years) in this field. The sample is selected to include the ECFs that implement QMS and practice measuring performance in their firms

The questionnaire was designed to verify the following:

- The efficiency of the proposed elements in measuring performance in Egyptian construction companies
- The ability of the indicators to express the performance of each element, and the practicality of measuring them as well.
- Exploring to what extent the point system is effective in measuring performance in Egyptian construction companies.
- Finding out to what extent the proposed model is applicable and practical, and identifying the obstacles that would obstruct applying the model, and how it can be overcome.

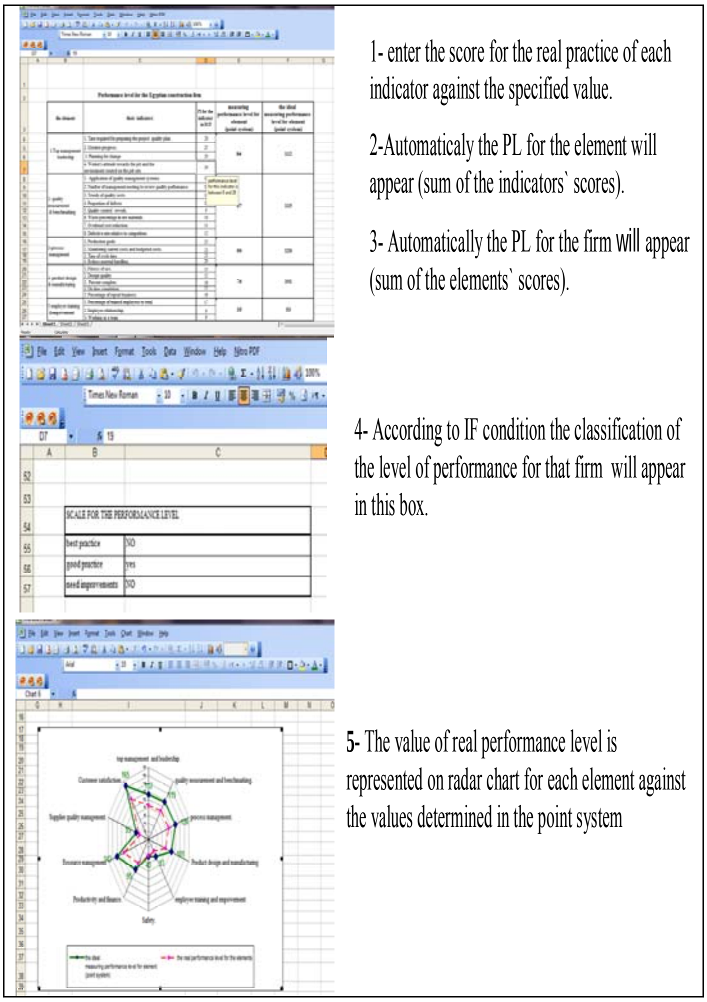

Fig. 6: Applying the model using Excel sheets

Responses from ten professionals were collected then coded to be analyzed using SPSS and it has been found that:

1-80% of respondents found the elements of the model are either enough or completely enough to measure the performance of the construction companies

2-The majority of respondents found the developed point system consistent enough with the elements` importance and their effect in measuring performance. That is because the mean score of their responses ranges from 1.3 to 2.3 in a scale from 1 to 4. which are considerably positive reactions

3-In their response to the Efficiency of suggested indicators ,the mean scores of responses ranges from 1.1 to 2.3, which indicate an agreement from the majority that the indicators of each element are sufficient enough to measure that elements and consequently the model is reliable for the measuring performance of the construction companies in Egypt. Also values of standard deviation were small for e most of the elements which reflects the small variation in the experts' opinions.

Table 7. Measuring elements and their corresponding indicators AND correlation between indicators and both applied QMS . And the degree f QMS implementation .Using (Pearson Chi- square)

(1) Element	(2) Corresponding indicators	(3)- Frequency	(4)- % of total firms (Real practice) (P_{rI})	Correlation		The model	
				(5)- Implemented QMS App. sig.	(6)- Degree of implementation on App. sig	(7)- performance level for element (point system)	(8)- Best practice of indicators
1-Top management leadership	1. Planning for change	51	**67.1%**	0.445	0.25	**112**	**28**
	2. Monitor progress.	41	53.9%	0.447	0.177		**28**
	3. Time required for preparing the project quality plan.	26	34.2%	**0.003***	**0.084****		**28**
	4. Worker's attitude towards the job and the environment created on the job site.	19	**25.0%**	0.409	0.588		**28**
2- quality measurement & benchmarking	1. Application of quality management systems.	29	**38.2%**	**0.002***	**0.043***	**115**	**14**
	2. Waste percentage in raw materials.	29	**38.2%**	0.318	0.227		**14**
	3. Proportion of defects	25	32.9%	0.35	0.168		**14**
	4. Overhead cost reduction.	25	32.9%	**0.008***	**0.086****		**14**
	5. Defective rate relative to competitors.	24	31.6%	0.111	0.406		**14**
	6. Trends of quality costs	17	22.4%	0.207	0.142		**14**
	7. Number of management meeting to review quality performance.	15	19.7%	0.345	0.461		**14**
	8. Quality control / rework.	11	**14.5%**	**0.004***	0.894		**14**
3-process management	1. Monitoring current costs and budgeted costs.	52	**68.4%**	0.133	**0.086****	**120**	**30**
	2. Reduce material handling.	50	**65.8%**	**0.049***	**0.046***		**30**
	3. Time of cycle time.	36	47.4%	0.475	0.442		**30**
	4. Production goals	25	**32.9%**	0.547	0.297		**30**
4- product design & manufacturing	1. On time completion.	45	**59.2%**	0.614	**0.026***	**101**	**20**
	2. Percent complete.	36	47.4%	0.85	**0.036***		**20**
	3. Fitness of use.	34	44.7%	0.505	0.642		**20**
	4. Design quality.	28	36.8%	**0.051****	**0.029***		**20**
	5. Percentage of repeat business.	13	**17.1%**	0.47	0.897		**20**
5-employee training & empowerment	1- Working as a team.	46	**60.5%**	0.228	0.189	**53**	**18**
	2. Percentage of trained employees to total.	35	46.1%	**0.086****	0.155		**18**
	3. Employee relationship.	17	**22.4%**	0.859	**0.077***		**18**
6- safety	1. Hiring the trained and specialist workers or employees.	47	**61.8%**	0.906	**0.011***	**43**	**14**
	2. Accidents, frequency.	28	36.8%	**0.001***	**0.028***		**14**
	3. Accidents, categories.	23	**30.3%**	0.357	0.188		**14**
7- productivity & finance	1. Gross profit, margin.	50	**65.8%**	**0.06****	0.546	**95**	**32**
	2. Productivity indictors of (labor, material, equipment and employee).	40	52.6%	0.907	**0.055****		**32**
	3. Return on employed.	34	**44.7%**	0.907	0.369		**32**
8- resource management	1. Resources on time with good specifications.	47	**61.8%**	0.335	0.391	**142**	**18**
	2. Budget and resources.	44	**57.9%**	0.473	0.232		**18**
	3. Total duration of breakdown times that results in stopping the works.	30	39.5%	0.38	0.272		**18**
	4. Market researches.	27	35.5%	0.813	**0.09****		**18**
	5-Percentage of waste in raw materials due to bad storage.	24	31.6%	0.462	0.325		**18**
	6. Maintenance plans.	23	30.3%	**0.005***	0.225		**18**
	7. Monitoring the productivity changes by the amounts of materials, tools, and equipment expended during construction	12	15.8%	0.881	0.426		**18**
	8. Lost time for waiting materials or equipments or people.	6	**7.9%**	0.331	0.679		**18**
9- supplier quality management	1- Material availability on time with good specifications.	56	**73.7%**	0.855	**0.022***	**55**	**18**
	2- Supplier relations.	28	36.8%	0.93	**0.076****		**18**
	3- Number of suppliers.	26	**34.2%**	0.892	0.111		**18**
10- customer satisfaction	1- Delivery on time.	60	**78.9%**	0.743	0.41	**165**	**27**
	2- Meeting the Customer requirements.	51	**67.1%**	0.143	0.117		**27**
	3- Closer to customer.	39	51.3%	0.888	0.122		**27**
	4- No. or percent of complaints.	23	30.3%	**0.001***	0.229		**27**
	5- Time and cost of handling these complaints	19	25.0%	0.415	0.212		**27**
	6-external distribution channels	11	**14.5%**	**0.016***	0.594		**27**
TOTAL						**1000**	**1000**

*** : correlation is significant at 0.05 level**
**** : correlation is significant at 0.1 level**

4-40% of respondents believe that the suggested indicators can be completely measured, and the others (60%) find these indicators are measurable to a big extent. On the other hand, no one find them non-measurable, the previous results insure that the selected indicators for model's elements are sufficient and practical for measuring the performance of construction firms in Egypt.
5-When asking about the efficiency of the point system, the majority of respondents (90%) agree that the point system can be used efficiently to measure the performance in ECFs, where half of respondents believe that the point system is completely efficient in measuring performance in construction firms in Egypt. On the other hand, only 10% see the point system fairly efficient;
6-70% of respondents find the model "applicable" and 30% find that it can be applied efficiently. Also the mean score of the responses is 1.7 with small standard deviation (0.483) referring to a high and consistent satisfaction from the experts to the model applicability.

Obstacles facing the developed model

- 70% of the experts see that lake of commitment of top management is a major obstacle.
- Also 60% agree that unavailability of data is a main obstacle against applying the model effectively.
- Other 70% see that training is needed for model application.
- However, 10% of respondents see no obstacles for applying the model.
- 80% of responses ranges between that the obstacles are totally manageable and it can be handled to a big extent. Only 20% of respondents see that the obstacles will need more effort to be overcome.

5. CONCLUSIONS

The research is trying to explore the influence of implementing QMS in Egyptian Construction Firms on MP. The real practice for all sampled firms (either adopting QMS or not) is investigated and the results showed that, in general the firms put more emphasize on the quantitative objective measures rather than the qualitative and subjective ones. However, correlation tests revealed a strong relation between QMS implementation and the qualitative measuring elements and their corresponding indicators which insures the positive impact of QMS on firm performance. Accordingly, the study developed a model for measuring performance that helps in strengthen the week points in the current practice and enhance measuring performance by the means of QMS principals. The model works in the basis of the point system that enables the ECF to benchmark its performance. The study also introduces a simple way of applying the proposed point system through excel sheets and standard Radar. The model has been verified by the mean of another questionnaire that has been answered by a group of experts. The verification results showed that the model can be applied effectively. And the obstacles of its implementation can be overcome by training, data gathering and analysis, and prior to all support and commitment of top management

REFERENCES

[1] Oakland, J., "Total Quality Management ", (3rdedn), *Elsevier Butterworth Heinemann*, 2003.
[2] Abd Elhamid, M. "The Development of Quality Management Systems for the Construction Industry in Egypt ", *Ph.D., Faculty of Engineering, Helwan University*, Cairo, Egypt, pp.62-80, 2002.
[3] Alarcon, L., and D. Ashley, "Modeling project performance for decision making", *Journal of Construction Engineering and Management*, vol. 122, No.3, pp.265-273, 1996.
[4] Eccles., R., "The performance measurement manifesto", *Harvard Business Review* vol. 69, No.1, pp.131-137, 1991.
[5] Abdel-Razek, R., " Performance Measurement for Construction Firm Using Benchmarking ", Proceedings of Symposium, Productivity and performance measurement, *Housing and Building National Research Center*, Cairo, Egypt, May, pp.20-35 , 2006.
[6] Motwani, J., "Critical factors and performance measures of TQM ", *The TQM Magazine*, vol. 13, No. 4, pp.292-300, 2001.
[7] Mossallam, A., " Developing & Implementing Non-Traditional Techniques in upgrading The Performance Level of Egyptian contracting firms ", *Ph.D., Faculty of Engineering, Cairo University* , Egypt , November , pp.14-28., 2002.
[8] Cox, R., et.al, "Management's Pereception of Key Performance Indicators for Construction ", *Journal of Construction Engineering and Management*, vol. 129, No. 2, , pp.142-151, 2003.
[9] Hassan, S., "Measuring performance in construction firms concerning quality management systems implementation ", *M.Sc.., Faculty of Engineering – Shoubra , Benha University*, Cairo, Egypt , 2009.
[10] Israel, G., "Determining sample size", *PEOD6, one of a series of the program evaluation and firmal development, Florida University*, November, 1992.
[11]Frank, D.K. and Adwoa, B.,
"Delays in building construction projects in Ghana", *Australasian Journal of Construction Economics and Building*, 10 (1/2), PP. 103-116, 2010.