

Implementing quality management in construction projects

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Abstract—Firms world-wide are actively engaged to achieve internationally accepted quality levels to ensure their position in the emerging international market especially those from developing economies. Unfortunately the construction industry, generally, has lagged behind other industries in implementing Total Quality Management (TQM) which provides excellence in customer satisfaction through continuous improvements of products, processes or services. The main reason for construction lagging has been the perception that TQM is for manufacturing and service sectors rather than the construction sector. The objective of this research is to study the implementation of quality management of construction projects in West Bank, Palestine. Construction sector is considered as a vital sector in today's economy, due to the development in construction which is taking place in the world in general and the West Bank. A survey of 300 contracting companies registered with the Palestinian Contracting Union (PCU) was conducted to establish the current quality management practices and managers perception of factors required for a successful implementation of TQM.

Keywords— Construction Projects; Total Quality Management; .

I. INTRODUCTION

Attainment of acceptable levels of quality in the construction industry has long been a problem. Great expenditures of time, money and resources, both human and material, are wasted each year because of inefficient or non-existent quality management procedures especially in construction projects.

But we have to keep in mind that the quality issues in construction management is not an easy task because this industry has numerous problems because of its complicated nature of operation, major and minor activities and this industry is comprised of a multitude of occupations, professions and organizations.

In Palestine, construction projects can provide a robust platform for refreshing the economy and for building a stable and autonomous economy during steady political conditions. In 1993, neglect of such systems, services, and institutions, however, has harmed the quality of life of Palestinians and their health and environment. But, after Oslo we can assume a period in which the Palestinian authority was formed and seeds

for stable economy were merged, which positively affects the construction sector.

A. Project Management

Project management is the application of knowledge, skills and techniques to execute projects effectively within time, cost, and quality, which are called the project management triangle. It's a strategic competency for organizations, enabling them to tie project results to business goals — and thus, better compete in their markets and develop the market share [1].

Project management is really important when the project faces changes, either these changes is internal or external, and when we need to make alternative solutions or implement contingency plans, especially in urgent cases in which the manager cannot keep the original plan.

B. Quality Definition

The British Standard Institution defines quality as “the totality of features and characteristics of a product or service that bear on its ability to satisfy stated and applied needs” [2]. Another definition is “fitness for purpose/use”. This definition is driven by customer satisfaction, and has become the principal definition of quality in manufacturing and service industry [3]. One important definition for quality should be mentioned in this manner which is quality is proportional to variability, in other words, as the quality increased the variability will be decreased [4]. This paper assesses the perceptions of the Contractors about implementing TQM in construction industry. The main factors that affect the implementation of quality system in the construction projects were identified.

II. LITERATURE REVIEW

A. Previous Studies

Several researchers [5,6] stated that many companies appreciate the necessity of the quality cost system; however, they continue to lack one. As a result, the companies are not able to recognize how much they lose because of poor quality

[6]. This implies a gap between the existing theory and the practical application regarding quality management.

TQM has the potential to improve business results, greater customer orientation and satisfaction, worker involvement and fulfillment, team working and better management of workers within companies. However, construction firms have been continually struggling with its implementation [7]. The implementation of a TQM philosophy within the organization requires a cultural change [8] and it's being recognized as an important aspect of total quality development [9].

The generally perceived factors that influence quality performance can be grouped under the headings of client, project environment, project team leaders, project procedures and project management action [10]. The elements affecting building construction projects are design, contract, material, labor, equipment, subcontractors, site layout, systems, site staff, and execution [11].

Quality policy is the overall intentions and directions of an organization as regards to quality, as formally expressed by top management [2]. The elements affecting quality of building construction projects in Taiwan is grouped into eight criteria: manpower qualified to achieve project mission, conformance to codes and standards, conformance to owner's requirements, conformance to design process and procedures, conformance to schedule requirements, conformance to cost requirements, and constructability [12]. TQM is greater than sum of quality, quality assurance and total quality. TQM is about continuously improving customer satisfaction by quality-led companywide management system. This goes beyond the mere application of total quality as a form of management itself [13]. TQM is a journey and not a destination [14]. The definition of TQM varies from organization to organization and even from individual to individual. Accordingly Saylor describe TQM as "both a philosophy and a set of principles "which are the foundation of a continuous improvement of the organization, which gives an implicit picture of philosophical component of TQM based on "continuous improvement" as the heart of TQM in all aspects of the business [15].

In construction industry, the quality is generally considered to be very costly, and Quality Control (QC) or QC/ Quality assurance (QA) organizations are established only as a result of contractual requirements. In construction industry, production is different from factory or plant production; therefore quality considerations need special care. Especially when the production (construction/installation) is not in place, cost of remedial works may go extremely high if attention is not paid to quality assurance [16].

B. The Models for TQM

This section illustrates the wide spread models for the TQM, the following table shows the most important models, the component of the models and the most important elements that have an impact on the construction industry [12].

TABLE 1. DIFFERENT QUALITY MODELS

Models	Description	Focuses	Main Elements
TQMEF (TQM-Efficiency) Model	Process & Efficiency, Customer Focused Performance, People Management, Team Building & Business partner Development	Process & Efficiency	Processes, Customer, people management
Oakland Model	(3C) Culture, Communication, Commitment + (4P) Planning, Performance, Processes + People	Commitment	Commitment, Culture, people, processes
MBNQA (Malcolm Baldrige National Quality Award)	Leadership, Strategic Planning, Customer & Market, Information and analysis, Human Resource Focus, Process management, Business Results	Leadership	Leadership, Human Resources, processes
EFQM (European Foundation Quality Management)	Leadership, People, Policy & Strategy + Partnership & Resources + Processes + People Satisfaction+ Customer Satisfaction + Impact on Society + Key Performance	Leadership	Leadership, People, Customers, Processes, Society

There are many models, and each model can provide an idea to any organization, but there is no model that can provide all the organization requirements, on the other hand each organization can create the most suitable model or framework that has been most suitable for its nature and conditions. Therefore, quality models or quality systems provide a concrete foundation to communicate as to how an organization should work and identify the responsibilities of all members participating in the organization. In Palestine, there is lack of interest in applying such models in construction projects, so our research objective is to enhance the awareness about these models and frameworks significance to achieve the required level of quality in construction projects, and to achieve the desired projects goals in terms of cost, quality, and time.

C. Construction sector in Palestine

The construction sector is one of the key economic sectors and the main force motivating the Palestinian national economy. In 1994, the construction sector has witnessed noticeable expansion. This has resulted in the recovery of the construction contracting profession and subsidiary industries; the construction sector has occupied the foremost position among the rest of sectors, mainly attracting investments and creating new jobs [17]. Construction sector contributes 33% to the Palestinian gross domestic product (GDP) [15]. Employs about 10.8% of laborers directly,

and 30% indirectly in factories related to the construction sector and other service and productive sectors. This is a large proportion covered by this sector, thus positively affecting various economic, social, educational and vocational sectors in addition to other Palestinian institutions [18]. The number of members classified contractors throughout West Bank have been (379) [20]. According to latest classification made for the year 2009-2010; (381) member have been classified in West Bank [17]. In 2011 the number of contractors increased to reach 422 contractors in West Bank [18], Fig. 1 illustrates the three main categories A, B and C which represent 252 companies, the contractors in Palestine are classified according to their capital, engineering and technical staff, experience, history of the achieved projects, and other issues.[19].

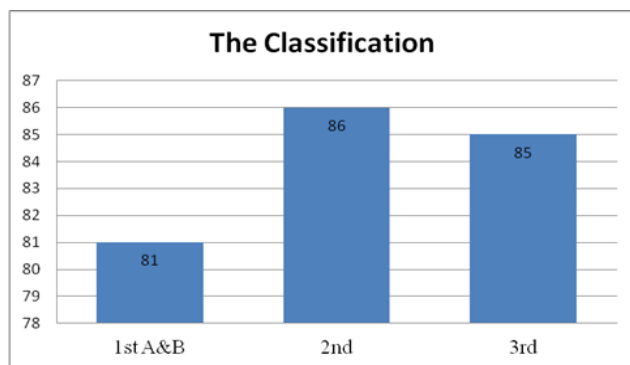


FIGURE 1 THE CONTRACTORS CLASSIFICATION IN PALESTINE. [18].

III. METHODOLOGY

The research will be initiated by interviewing some local firm owners, consultants, contractors and managers of donor countries' institutions to collect data about the status quo. Simultaneously, the information required to support the proposed research will be collected by distributing 300 questionnaires to different construction companies. Then, the data will be analyzed to perform the required analysis. Finally the research conclusions and the related recommendations are included.

The researchers chose the three main categories A, B and C; because it was found that about 95% of the total projects' values were executed by the first three degrees of the registered classified contractors (PCU records). Therefore, the researchers decided to focus this study on the contractors of these three degrees because they have the most noticeable effect on the execution of the projects in the West Bank but as aforementioned the other classified contractor will be consulted with inferior priority. The sample consisted of 300 contractors who work in West Bank in the 2013/2014, the respondents is 230. Those contractors aged from 20 to more than 60 years, their qualifications ranged from (Diploma to Ph.D. and other qualifications). Moreover, the respondents were varied in terms of job title and years of experiences. The demographic variables are shown in Tables 2 and 3.

TABLE 1 DISTRIBUTION OF SAMPLE ACCORDING TO STUDY INDEPENDENT VARIABLES OF THE CONTRACTOR

Variable	Class	Frequency	Percentage %	Rank
Qualification	Diploma	21	9.1	3
	B.A	148	64.3	1
	M.A	51	22.2	2
	Ph.D.	4	1.7	5
	Others	6	2.6	4
Age	20-29	108	47.0	1
	30-39	78	33.9	2
	40-49	24	10.4	3
	50-59	17	7.4	4
	More than 60	3	1.3	5
Job Title	Resident engineer	111	48.3	1
	Quality control manager	12	5.2	5
	General Manager	38	16.5	3
	Director	18	7.8	4
	Others	51	22.2	2
Years of Experience	Less than 5 years	99	43.0	1
	5-9	51	22.2	2
	10-14	36	15.7	3
	15-19	18	7.8	5
	More than 20	26	11.3	4
Total		230	100%	

TABLE 2 DISTRIBUTION OF SAMPLE ACCORDING TO STUDY INDEPENDENT VARIABLES OF THE COMPANY

Variable	Class	Frequency	Percentage %	Rank
The main-sector of projects that company dealing with	Building	104	45.2	2
	infrastructure	111	48.3	1
	Electro-mechanical	6	2.6	4
	others	9	3.9	3
Number of projects that the company has accomplished so far	0-9	54	23.5	2
	10-49	78	33.9	1
	50-100	44	19.1	3
	more than 100	54	23.5	2
Number of employees that the company have	Less than 50	95	41.3	1
	50-100	48	20.9	2
	100-150	63	27.4	1
	150-200	15	6.5	3
Number of engineers that the company have	More than 200	9	3.9	4
	Less than 5	62	27.0	1
	5-10	60	26.1	2
	10-15	36	15.7	4
Total	15-20	18	7.8	5
	More than 20	54	23.5	3
Total		230	100%	

A. Study Barriers

They are many constraints and barriers that faced the researchers during the conduction of the research. The most important barrier was determining the number of the contractors because it is allowed for the contracting companies

to have several classifications in different specializations, so one company may be counted several time.

Most of the contractors showed lack of cooperation, they considered the research as an academic material lacking the ability to be practiced and implemented; some contractors delegated the answers to office engineers, or to an inferior position in the firm. The researchers had no control to ensure the most appropriate person was assigned by each company to be interviewed although they had done their best.

The willingness of the respondents to reveal weaknesses in their respective organization was uncertain due to cultural issues in which persons did not like to show their weakness even if the researchers keep reminding them that this is a research for academic purposes only.

Due to work commitment, some respondents could not fully concentrated on during the interview sessions, this caused the intended in-depth interview could not be fully achieved. The contractors did not have enough time to respond due to the work pressure, so the researcher had to keep reminding them to respond to the questionnaire to achieve a good percentage of responsiveness.

IV. RESULTS

Based on the results of the interviews and the distributed questionnaires, we conclude the following:

- 28.7 % of the respondents have no Quality System in their firms and organizations.
- 37.8% of the respondents have no quality department in the organizational structure of their firms.
- 49.6% of the respondents have no ISO-Certificate in their firms and organizations.
- 28.7% of the respondents rating the customer satisfaction with low or none degree which is an evidence of low awareness of customer relation issues and its direct relation with the successful implementing of total quality system.
- 42.6% of the respondents rank the quality as the most important factor among the work factor that affecting the construction project. On the other hand, 41.7% of the samples believe that the TQM will be beneficial for the organization.

According to the questionnaire that discussed the critical factors that affect the implementation of quality system in the construction projects, the highest item with the first rank is the skilled work force with score of 4.05 and which supports the importance of the training programs in the construction organizations for the labor and technicians to increase their abilities, capabilities and skills.

According to the questionnaire regarding the barriers that faced the quality system in construction projects; the highest rank is the lack of the knowledge and skills which recorded the highest rank with 4.06.

Regarding the benefits of implementing quality system in construction project; according to the questionnaire, the highest rank is keeping performance improved; as a result of that we suggest to make the auditing and feedback of quality as a continues process and to make the benchmarking in which we compare our current performance with rivals and competitors and in the same time with our performance last periods.

Regarding techniques according to the questionnaire the respondents ranked the lap experiment as the most important tool to be used to improve the quality in the construction project, so the top management commitment to conduct the required experiment is very essential to keep an accepted and consistent level of quality in the project.

On the other hand we have to launch a training session for the contractors engineers to improve their perception about the laboratory experimentation to make them consider it as a crucial process to make sure of the quality of the performance, structure and component of materials; rather than consider it as a rubber stamp process, or a routine process with no beneficial result.

Moreover, daily, weekly and biweekly reports are the least important technique to enhance the quality issues in the construction project. Most likely, the contracting companies consider the documentation issue is an exhausting process with no advantage regarding the quality.

V. RECOMMENDATIONS

The following are practical recommendations to the all interested institutes; owners and to contractors which could lead to better quality system practices in West Bank:

1. The funder should introduce polices toward awarding tenders to the most accurate cost and not necessarily to the lowest price, the accurate cost to ensure will take into account the quality issues are taking into account.
2. The funder, owner, or generally the client is advised to make high control and upgrade the contracts items and do not allow any violation regarding the quality issues, and to motivate the contractors not to treat the quality issues as a contractual requirement, but to encourage them to stick to the quality management concepts.
3. It is highly recommended to PCU and Association of Engineers to conduct continuous training and education programs through training courses, lectures, seminars, and workshops that helps them to be familiar with quality concepts and primarily its benefits. These training programs aim to increase contractors realizing and understanding of quality

importance and to improve their practices for future quality management.

4. Contractors are advised to review all contracts documents very well before signing the contract. They should give themselves enough time to study these documents and make necessarily site visits to take a good picture of the contract conditions and the quality issues related to the proposed work. Moreover, they should take advice, support, and assistance from experts to explain any ambiguous item or unclear sentences, moreover they should review the method of statement they submitted to the consultant; this method of statement should be reliable and applicable.

5. Contractors are advised to move seriously toward achieving a comprehensive quality system in their organizations, that include creating a quality department in the organization structure; hiring a quality control engineers; and to achieve a certified degrees in quality commitment the ISO certificate as an example.

6. Contractors should think deeply before making any sub-contracting with other firms, evaluate the situation and the condition, if it is beneficial or it will harm the firm interest and damage the quality system of the firm; this may lead to lose the competitive advantage of being a considerable rival in the construction sector.

7. The contractors should think deeply about the tradeoff of the projects component, because the quality is more important than the cost in some cases to keep the firm reputation, so they have to judge after evaluating the whole situation rather than thinking based on the cost perspective.

8. Successful implementation of TQM in the construction projects can be achieved through developing effective quality management system, persistence, and positive hands on leadership. Accomplishment in quality performance requires that top management should be dedicated to that ambition. In other words, those in top management must provide the initiative, direction commitment, resources for successful quality assurance practices and must support the quality program in the organization if such a program is to be successful.

Future Research

Future research should look at performance of quality management practices of these firms in relation to customer satisfaction, employee satisfaction and product adequacy (quality and organizational efficiency in relation to cost and time). Also, further studies should look at the relationship between the identified factors and the performance of quality management practices.

One more research is to study the effects of the human factors on the quality issues in the construction project in West

Bank. Other researchers may evaluate the current status of the quality issues in the construction projects in West Bank, or assess the most important barriers affecting the deployment of quality concept in the construction sector in the Palestinian state.

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