

## **Evaluation of Total Quality Management Implementation as Engineering Practices in Jordanian Construction Projects**

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**Abstract:***The construction sector is one of the most important business fields in Jordan and this sector is suffering from many problems in Management and quality. Total quality management (TQM) process is considered as a modern system in the field of quality.*

*The purpose of this paper is to evaluate TQM implementation as engineering practices in different construction projects phases. In order to achieve this objective, literature review has been carried out to identify the two main factors influencing the implementation of TQM factors in the construction process: (continuous improvement, customer satisfaction).*

*And by examining the four ISO 9001-2008 requirements to achieve important TQM factors in construction process. In this study, the data was collected by a questionnaire survey, the survey analyzed by statistical software SPSS.*

*More than 204 questionnaire forms were distributed, 177 was responded which was represented 86 % of the total spread questionnaire forms, the respondents were engineers only(Civil, Mechanical, Electrical and Architectural).*

*By analyses of results, the study showed that TQM implementation level in all construction projects phases was moderate in Jordanian construction process.*

**Key words:** *Total quality management, ISO 9001-2008, Customer Satisfaction, Continues Improvement.*

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### **I. Introduction:**

The main attention of total quality management (TQM) and its application in construction projects to establishment of high-quality facilities and Raise the performance level in construction Process. TQM appears to be a very important concept which is difficult to summarize in a short definition. TQM is a process lead by senior management to obtain involvement of all employees in the continuous improvement of the performance of all activities.

Therefore, this study evaluated the two main TQM factors in construction project (customer satisfaction and continuous improvement) by examining the apply of four ISO 9001-2008 requirement during different project phases.

Because of instability in the Middle East, especially wars in Iraq, Syria, Lebanon, Palestine, has resulted in an increased immigration percentage in the recent years to Jordan. This big number of people has increased the demand to develop the country infrastructure, in addition to the necessary needs such as, houses, hospitals, hotels, schools and entertainment places. So it's important to adopt TQM concept which affecting positively on the entire construction industry and company reputations, with a result that caused a rapid rise in the quality scale to the highest level (Bani Ismail, 2012).

Despite the international adoption of the TQM concept, it has not been developed within the Arab area , as a result from the lack of basic knowledge of TQM and low level of organization' readiness for change (Haffar, 2010).

### **II. Literature Review:**

TQM is one of most important techniques to improve quality, which many organizations and companies are using to reach success. the wide implementation for TQM all through the world in different sectors and industries. The positive results appeared in these sectors and industries because of TQM implementation (Bhat and Rajashekhar, 2009).

The purpose or function of TQM is to provide a high quality product to the customers, in turn increase the productivity also customer satisfaction , furthermore decrease the cost With lower price and a higher quality

product, TQM is approach of managing different industries to improve the quality of product (Kumar, et al., 2011).

And its show Establish strategic goals, mission and vision based on the concept of TQM and bind all parties together including subcontractors of these goals. The Organizations need to follow continuous improvement while maintaining a long-term Perspective. The improvement will have to be made both in the processes and the organizational system in order to make the TQM program successful (Al-Tayeb Mustafa, 2008)

(TQM) Total quality management is defined as both a management of quality philosophy and group of guiding principles that promote culture in organizations and all members participation in organization aiming to achieve long term success process through continuous improvement and customer satisfaction of products, and the benefits for all society members (Juran et al., 1999; Rampersad, 2001; Besterfield et al., 2003)

### **III. Definitions of Total Quality Management**

The Asian Institute of Technology (AIT), define TQM as “a philosophy that strengthens and support the culture to foster continuous organizational improvement through integrated, systematic, consistent and reliable effort involving everything and everyone, focusing primarily on total satisfaction of internal and external customers, where employees work together in teams with process ownership, guided by a committed top management, which takes a practical participation” (Nukulchai, 2003).

Also, according to the British Quality Association defines TQM as “an all-agreement business management philosophy focusing on completely fulfilling customer requirements with a maximum of effectiveness and efficiency” (Wessel, 2004).

According the previous definitions, define the TQM as a philosophy but the different point of view. British Standard (BS) described the TQM as the management philosophy aimed to achieve organization objectives. While, the (AIT), defined the TQM as the philosophy aiming to satisfy the customers.

Out of above definitions, a easy definition of TQM is a get-together of external and internal customer requirements, and the difference between quality and TQM is that the quality expression generally focuses on a temporary process.

In construction project for example, in order to achieve a good strength for concrete according to the specifications, the concrete should be cured by water for (3-4) days, to reached for the required quality, so this is a temporary process, while TQM is a long term process and adopts a strategic dimension, to lead each financial, production, marketing and managerial plan in the path which support the strategic dimension. From the previous definitions, the researcher conclusion was that the definition of TQM is an old concept, but in last years it appears as an official job.

#### **Basics of TQM Principles in construction projects:**

The concept of TQM is modern in construction projects. It was only applied to industrial projects, the construction companies in the United States applied (TQM) after the noticed the great success of industrial companies by the application of the concept of TQM which is based on the achieving the basic principles: customer satisfaction, continuous improvement. These principles will be defined and clarified and how they will be applied in construction projects. (Gamld D. Oberlender 2000.)

#### **Customer Satisfaction:**

The basic function of the construction industry is to provide customers projects, facilities and services ready to use, and meet their requirements. Any construction company must be completed its work at a competitive cost to guarantee continuous work. TQM is a management philosophy based on identifying customer needs and requirements exactly and work to make suitable environment and working conditions suitable to achieve the needs and requirements at the lowest possible cost, by quality control at every stage of the construction process. While the construction project is an idea to close out and ready for use, this quality of the final product will be satisfy the customer needs.

#### **Continues Improvement:**

##### **To Continues Improvement we have to:**

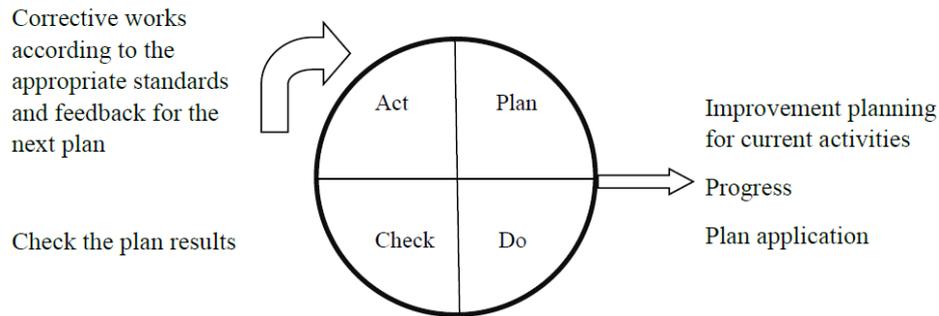
- Continuous improvement for current methods and procedures and to keep existed improvements during the product processing control.
- Concentrate on achieving technological development in construction and engineering process during innovation and creation.

The construction project consists of a group of activities so we want to develop, innovate and create in each activity to achieve quality and fulfill customer satisfaction.

During each activity implementation we have to reduce gap between the customer requirements and current status, during the use of problem analysis process by using Deming cycle "Plan-do-check-act", which its

considered as a procedure for continuous improvement by concentrate on correction procedure and defect prevention.

Deming cycle contain four process Occur every time and constantly repeated and apply it in each process as show in Figure(1),and Table (1) show Eight steps for each Deming cycle process .



**Figure (1)**Eight steps for each Deming cycle process

**Table (1)** shows Eight steps for each Deming cycle process .

Plan	-Identify the problem and improvement aim. -Analyze the current status -Determine the root causes and its affect -Develop plans for corrective works
Do	-Apply the plan and its implementation.
Check	-Document the implementation plan result to compare it with main plan aim.
Act	-Create the criteria for the necessary steps to avoid problem repeated -Reprocess and take in consecration rest of problems or suitable improvement in the next plan stage.

### ISO 9001-2008

ISO 9001:2008 it's the last version sets out the criteria for a quality management system and concenter only standard in the family that can be certified. It can be used by large or small organization, regardless of its field of activity.

Moreover, the ISO 9001:2008 is implemented by over one million companies and organizations in over 170 countries (ISO technical committee.2008)

There are four ISO 9001-2008 requirements to Achieve TQM important factors in construction projects. (The continuous improvement and customer satisfaction) as shown in Figure (2):(International standard ISO 9001, 2008).

1. Management responsibility.
2. Resource management.
3. Product realization.

Each of The four ISO(9001-2008)requirements includes a number of elements

4. Measurement, analysis and improvement.

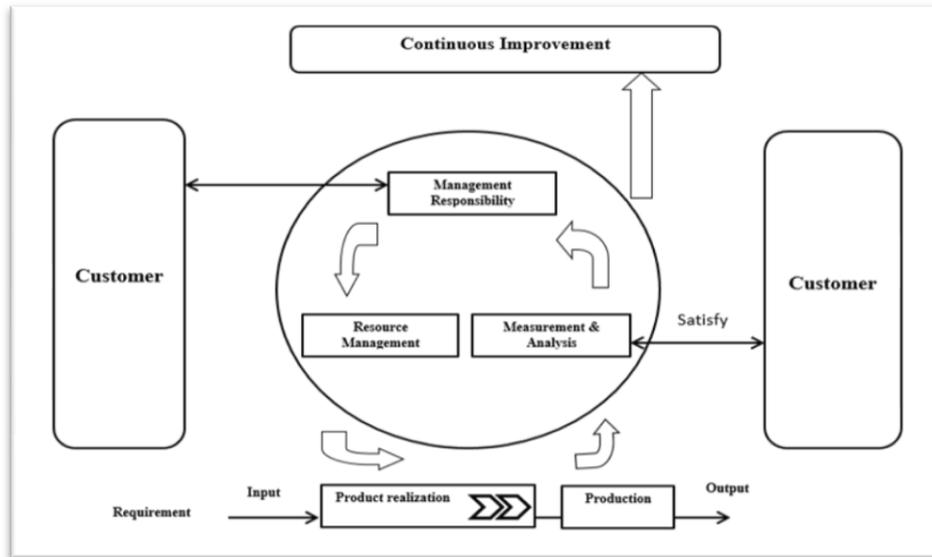


Figure (2)

**Questionnaire design**

Questions in a questionnaire were formulated based on the literature review as main sources to get the initial form of questionnaire; the Figure ( 3 ) shows the questionnaire development process.

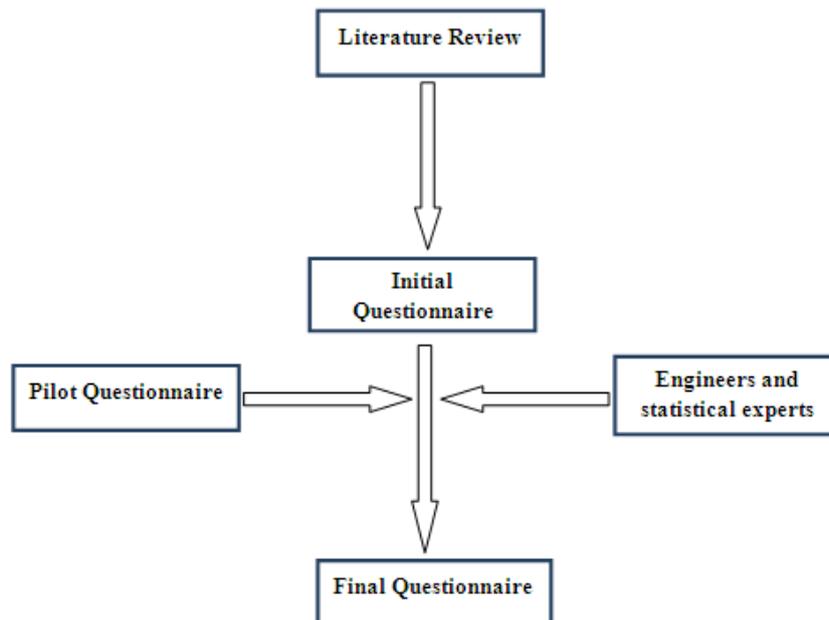


Figure (3) Questionnaire design

**Results of factor analysis:**

The result of the output obtained in this research could be presented as followed: The items in the survey were made on a five points likert scale where 5 implied strongly agree, and 1 Indicated the respondent strongly disagree with the statements. The item of the questionnaire was conducted by using SPSS package version 16.0 to detect the factor structure in the variable and Table ( 2 ) show the mean, Standard deviation and Skewness values for all project phases:

St. Dis.	Study			Design			Contract document		
	M	Sd	Sk	M	Sd	Sk	M	Sd	Sk
<b>M.R</b>	3.33	0.64	-0.02	3.17	0.69	-0.12	3.15	0.82	-0.22
<b>R.M</b>	3.13	0.72	-0.04	3.24	0.76	0.05	3.16	0.72	0.04
<b>P.R</b>	3.48	0.55	-0.20	3.38	0.77	-0.27	3.18	0.81	-0.18
<b>M&amp;A</b>	3.03	0.81	-0.09	3.38	0.75	-0.44	3.25	0.74	-0.10
<b>Overall</b>	3.24	0.55	-0.11	3.29	0.61	-0.29	3.19	0.70	-0.05

St. Dis.	Contractor Selection			Implementation			Close out		
	M	Sd	Sk	M	Sd	Sk	M	Sd	Sk
M.R	2.86	0.79	0.20	3.13	0.68	-0.16	3.21	0.83	-0.21
R.M	3.17	0.74	0.21	3.09	0.73	-0.09	3.14	0.75	0.39
P.R	3.27	0.70	-0.25	3.26	0.75	-0.36	3.19	0.84	-0.07
M&A	3.27	0.69	0.18	3.00	0.66	0.09	3.15	1.01	-0.18
Overall	3.14	0.55	0.30	3.12	0.63	-0.18	3.17	0.75	0.09

Table ( 2 ) Statically descriptive for different project phases

**Evaluation of TQM Implantation as engineering practice**

The stages were divided in the questionnaire to six phases. In addition to that, the classifications for mean values in the upcoming Tables will be based on the following criteria as suggested by researcher as shown in Table (3):

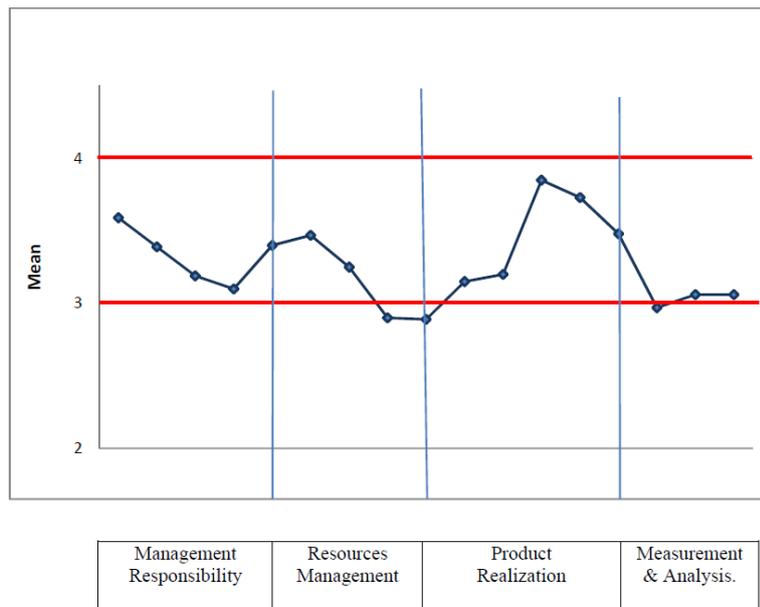
Table (3) Evaluation level

Category	Weak	Moderate	High
Mean	< 3	3 – 4	>4

TQM factors were then analyzed according to six construction projects phases as in the following:

**- Study phase**

conclude from Figure(4) that all mean values are moderate in all ISO requirments (management responsibility and product realization) but in resources management there are two values under the mean (weak evaluation),at which There was a shortage in work invironmental analysis and resources procurement. In (Measurement and alanalysis) there was no study review and check by any neutral part.

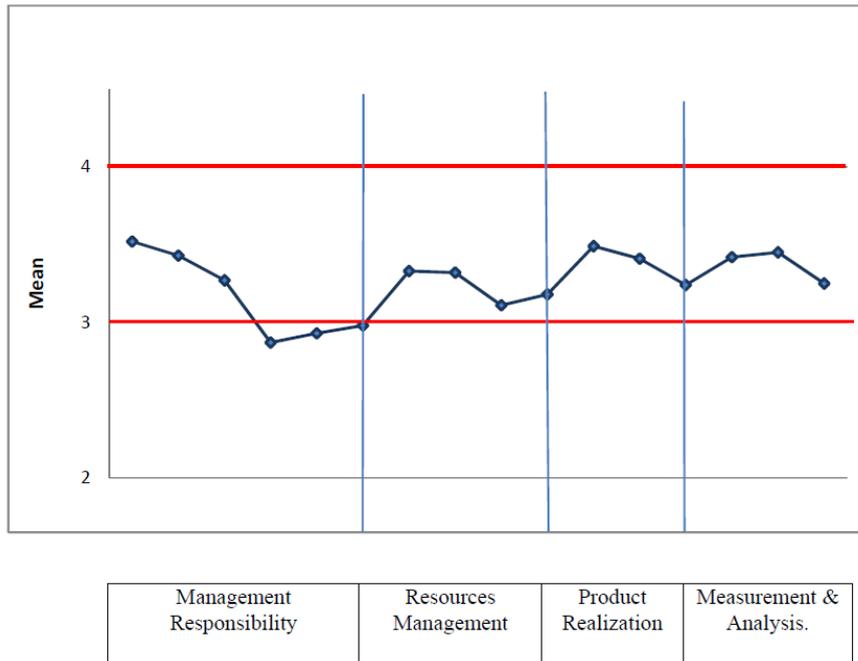


Figure(4)Current state of TQM in study Phase

In general the overall TQM implementation factors in study phase is moderate.

**3.9.2 Design phase**

According to Figure(5), that all mean values are moderate in all ISO requirments (resources management, product realization and measurement and analysis ) but in Management Responsibility there are three values under the mean (weak evaluation) at which insufficient responsibility and Authorization ,lack communication and design change approval.

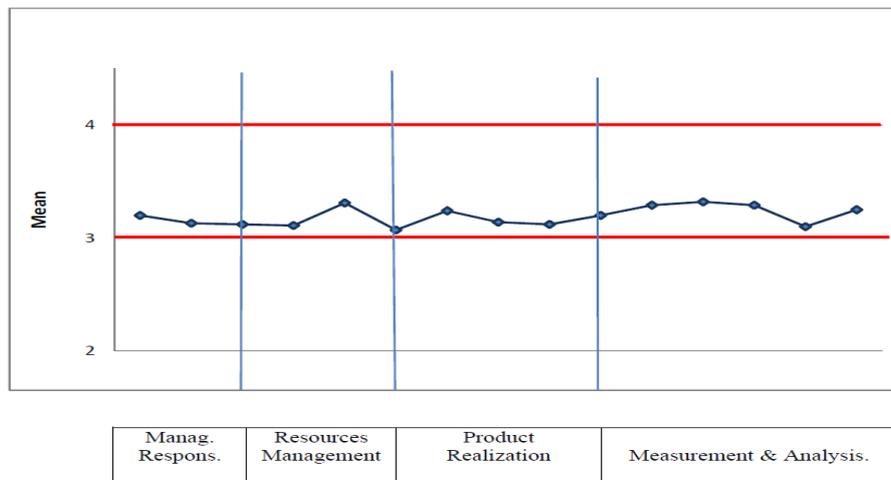


**Figure(5)** Current state of TQM in designphase.

In general the overall TQM implementation factors in design phase is moderate.

### 3.9.3 Contract documentsphase

According to Figure(6), that all mean values are moderate in all ISO requirements (management responsibility,resources management, product realization and measurement and analysis).

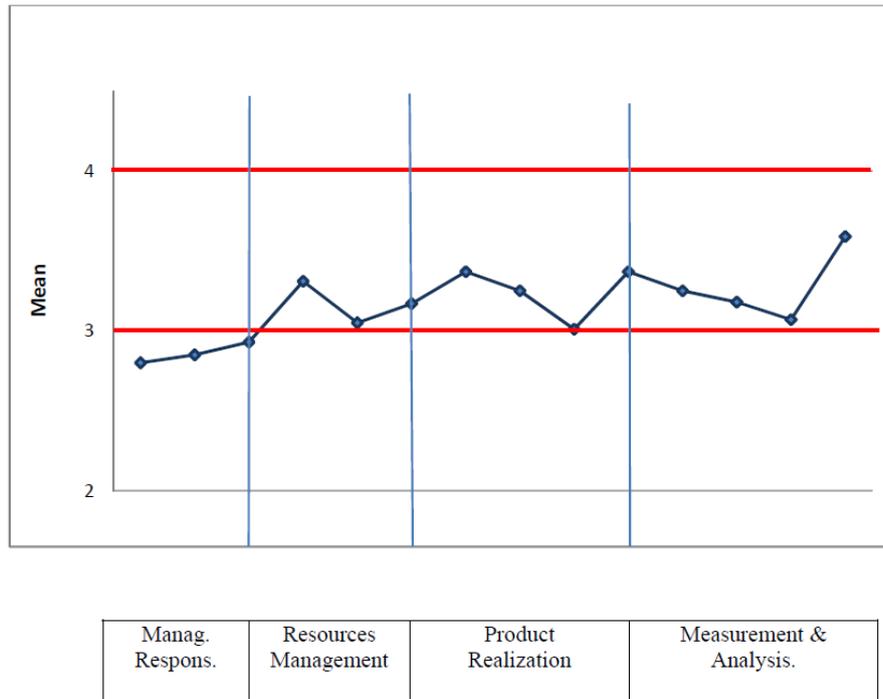


**Figure(6)**Current state of TQM in contractdocumentsphase

In general the overall TQM implementation factors in contract documants phase are moderate

### Contractor selection phase

According to Figure(7) that all mean values are moderate in all ISO requirments (resources management, product realization and measurement and analysis) but in management responsibility there are three values under the mean (weak evaluation) at which the contractor was selected according to financial categories rather than experience and insufficient responsibility and Authorization .

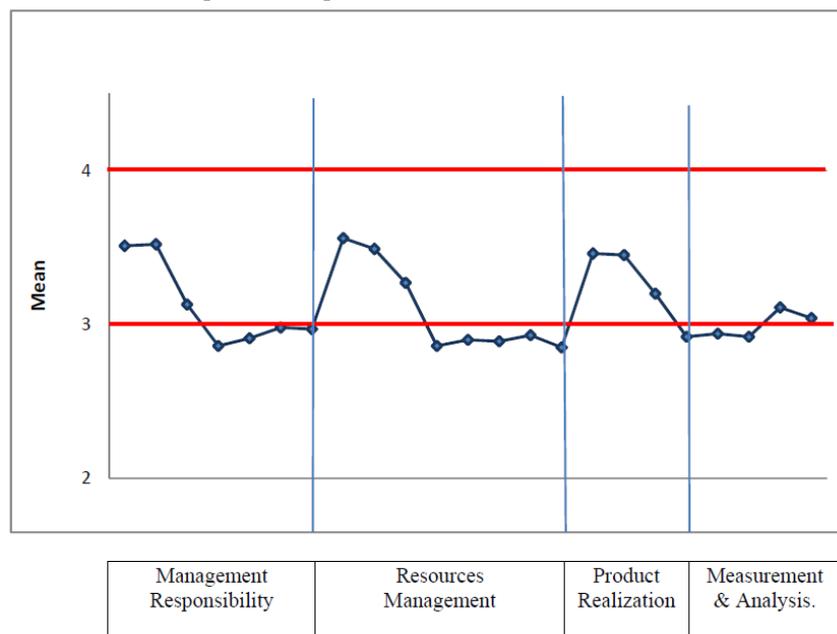


**Figure(7)**Current state of TQM in contractor selection phase

In general the overall TQM implementation factors in contractor selection phase is moderate.

**Implementation phase**

conclude from Figure(8),that overall mean value for management responsibility is moderate but four values are considered (weak) due to improper cash flow, no detailed project's budget , lack of communication among project parties and lack of commitment inproject duration.That overall mean value for resources management is moderate but there are five values considered (weak) mean value. Such as poor raw material quality ,there is no technical staff,inappropriate labor wages ,shortage in site mobilization and poor safety procedures.The overall mean value for product realization is moderate but there is one low value(weak)at which no control and analysis for construction test.The overall mean value for measurement and analysis has a moderate mean value but there are two values with low mean value (weak) at which there is a lack in check and test to diagnose the defects ,and no preventive procedures .

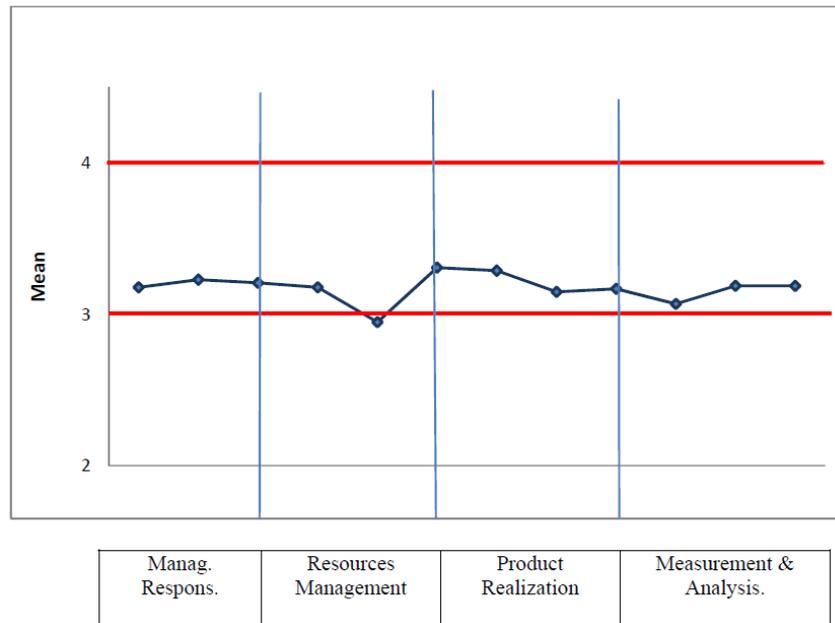


**Figure(8)** Current state of TQM in implementation Phase

In general the overall TQM implementation factors in implementation phase is moderate.

**Close out phase**

According to Figure (9) that all mean values are moderate in all ISO requirements (management responsibility, product realization and measurement and analysis) but resources management has one value under the mean (weak evaluation) at which there is a lack in staff training.



**Figure(9)** Current state of TQM in close outphase

In general the overall TQM implementation factors in close out phase is moderate.

**IV. Conclusion:**

- 1) TQM factors applied in the Jordanian construction projects are classified as a moderate level because some of (four ISO requirement) in the project phases are weak.
- 2) In study phase found that there a huge weakness in the analysis of work environment, there is no third or other neutral part are checking the Study, and the owner satisfaction is adopting as criterion of effective performance criteria in quality management system.
- 3) In design phase there is a big weakness because of authorizing some responsibilities and authorities from top Management to the designer to ensure work efficiency, also lack in coordination between the owner and designer will affect the project completion according to the requirements, but the design documents were clear and suitable for requirements.
- 4) Contract documents phase was the best among the different phases, where the documents are approved before concluding the contract; also take advantage of previous contracts to develop the final form of the contract.
- 5) There is a large shortage of management responsibility in contractor selection phase, found that the contractor selection was not according to experience, efficiency and price, contractor select was according to the lowest total price only, but the feature of this phase is there are a third party to resolving disputes if there.
- 6) The implementation phase was the worst among the other phases where :
  - a) There is huge weakness in the four ISO requirements to apply TQM factors application in this phase.
  - b) Also found that no interest of using high quality raw materials.
  - c) There is no enough coordinate to information exchange and Periodic meetings between the project parties (owner, designer and executer).
  - d) The working staff wages are not appropriate with the assigned to it works to ensure quality, also weakness in health and safety standards in the projects.
  - e) Weak in monitoring and analyzing construction tests to measure the conformity with the specifications and lack in the preventive procedures to guarantee avoiding the no confirm occurring.

- 7) In close out phase the training sessions are not available for the working staff to improve their qualifications, there is a concern to make the contractor to repair the diagnosed defects before the facility occupied, impose discounts when found nonconforming product for the owner requirements.

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