

# Evaluation of Quality Management in Irrigation Projects

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**Abstract:** *Construction, in one form or the other, has been practiced since the dawn of civilization. In India, construction industry is the second largest industry next to agriculture. The importance of construction can be gauged from the simple fact that cost of construction of certain infrastructure projects may be as high as 60- 80 percent of the project cost. In this vast country, irrigation in various forms has been practiced for ages and a large number of various types of old irrigation systems are still in operation with their own well-established irrigation practices evolved out of experience. Irrigation projects in construction industry contribute to the prosperity of the state. Evaluation of irrigation projects involves enormous expenditure. They are time bound programme and require assistance from various technical bodies for investigation, design, planning and execution. In this research 07 project site were visited. Further study was done to extract the factors, especially the factors that give rise to delay in construction which further affects the quality management. A total of 42 factors were extracted and were divided into 04 groups. These groups were general, materials and equipments, management and others. Ranking of factors were done using relative importance index (RII) method.*

**Keywords:** Construction, Quality management, Relative importance index

## 1. Introduction

Construction, in one form or the other, has been practiced since the dawn of civilization. In India, construction industry is the second largest industry next to agriculture. It generates substantial employment. It employs not only engineers, managers and skilled workers, but also unskilled male and female workers from rural and urban areas. The importance of construction can be gauged from the simple fact that cost of construction of certain infrastructure projects may be as high as 60- 80 percent of the project cost.

In this vast country, irrigation in various forms has been practiced for ages and a large number of various types of old irrigation systems are still in operation with their own well-established irrigation practices evolved out of experience. Furthermore, during the various five-year plans, from the first to now the ninth, a large programme of construction of several of irrigation systems has been undertaken and phenomenal progress has been achieved. The ultimate potential of about 120 million hectares of irrigation, as currently assessed by various sources in this country, is likely to be achieved in the second decade of the next century.

In each state, and even in parts of each state, there is tremendous variation in the basic environmental factors such as rainfall pattern and intensity, ground profiles, soil types and depths, spread of rural population, and agricultural practices, and obviously irrigation policies and practices have to be developed keeping in mind these basic factors. In the continuous process of learning, in addition to the phenomenal work done by the irrigation fraternity in this country, the contribution received from the international community has also to be acknowledged.

Irrigation projects in construction industry contribute to the prosperity of the state. Evaluation of irrigation projects involves enormous expenditure. They are time bound programme and require assistance from various technical

bodies for investigation, design, planning and execution. To have a safe durable structure, it is necessary that the materials and standard of execution fully satisfy the specifications. It is to be recognized that the ultimate efficiency of the performance of a project will depend upon proper layout and designs, the ultimate health of the project during life scale of its operational phase will depend largely on the quality achieved during its construction. Each and every job whether big or how so ever small shall require to be executed to acceptable construction quality duly confirming to sound design principles, specifications and deployment of good methodology or modern technique and procedures.

## 2. Objectives of Study

The aim of this research can be broken down into the following objective.

1. To study the quality management in construction industry.
2. To study and evaluate quality management for construction irrigation projects.
3. To carry out literature review.
4. To identify quality management parameters for irrigation projects.
5. To collect data of existing irrigation projects for evaluating quality management.
6. To analyze data collected using RII method.

## 3. Literature Review

(Jha K.N and Iyer K.C., 2006) Quality in its simplest form can be defined as: „meeting the customer’s expectations, or compliance with customer’s specification. Quality is nothing but satisfaction with the appearance, performances, and reliability of the project for a given price range. This paper explains critical success factors obtained such as project manager’s competence, top management’s support, monitoring and feedback by project participants, interaction among project participants and owners” competence. Also

suggests the factors that adversely affected the quality performances of projects such as conflict among project participants, hostile socio-economic environment, harsh climatic condition, PM's ignorance & lack of knowledge, faulty project conceptualization, and aggressive competition during tendering.

(Mailot Sysoulath and Noppadon Jokkaw, 2015) Construction projects have been increased continuously in developing countries such as ASEAN countries. The construction works have been concerned with many problems such as low productivity, poor quality, and lack of standards. This paper suggests identifying factors affecting the quality of construction works regarding negative effects in Lao PDR and to assess the relative importance level of each factor. The data was collected in Vientiane, the capital city of Lao PDR and analyzed by the relative importance index (RII) technique.

(Adnan Enshassi, Sherif Mohamed, Saleh Abushaban, 2009) Construction projects located in the Gaza Strip, Palestine suffer from many problems and complex issues. This paper Analyses the factors affecting the performance of local construction projects and to elicit perceptions of their relative importance. Also formulates a number of recommendations in order to bridge the gap between the different perceptions thus improving the level of project performance in the Gaza Strip.

(Anne Landin, 2000) The demand for quality assurance comes primarily from the central authorities via the client and quality systems should be applied in the whole chain involved in the process. The aim of this paper is to investigate how the concept of quality management is adopted in the construction process and the impact it has. The work associated with quality was studied in several companies and these companies were chosen from different categories in order to cover the whole construction process. Companies representing clients, architectural/ engineering companies as well as different types of contractor were studied.

(Raji Al-Ani and Firas Al-Adhmawi I., 2011) Quality has been considered one of the most important and competitive factors amongst the constructing companies during the past two decades. This paper aims the quality management concepts and its application in construction industry. It has become clear that the responsibility of achieving applications of quality management concepts shall be borne by the construction management and its personnel. The researchers have recommended a proposed quality management system for construction site to raise the quality level of works in construction projects, to improve the construction staff consciousness, in different managerial levels, about quality management concepts and its importance for improving the quality of construction works. The researchers have come out with certain conclusions, above all is that this proposed quality management system for construction site will improve conducting quality management concepts in achieving construction works by construction companies.

(Teena Joy, 2014) The construction industry plays a vital role in the economy. The need for achieving quality of the finished product in the building construction is very

important. Quality is an essential element for sustainability and customer satisfaction. This paper also suggests to provide clients, project managers, designers, and contractors with necessary information needed to better manage the quality of a construction building projects by identifying the factors that affect process quality of construction projects and to rank them by degree of importance will be a key component of any organization which move towards achieving best practice in order to overcome the quality performance problem in the construction projects.

(Abdulaziz Bubshait A. and Tawfiq Al-Atiq H., 1999) There is risk involved in any construction project. This paper aims a contractor's quality assurance system which is essential in preventing problems and the reoccurrence of problems. The ISO 9000 clauses most often complied with are those dealing with inspection and test status; inspection and testing; control of nonconformance product; and handling, storage, and preservation.

(Ying Cao, 2010) Quality is the symbol of human civilization, and with the progress of human civilization, quality control will play an incomparable role in the business. It can be said that if there is no quality control, there is no economic benefit. Construction projects are an extremely complex process, involving a wide range. There are plenty of factors affecting the quality of construction, such as design, materials, machinery, topography, geology, hydrology, meteorology, construction technology, methods of operation, technical measures, management systems etc. The purpose of this paper was to find out the shortcoming of quality management in construction projects of Third Chemical Engineering Construction Co. Ltd. (TCC) to help them strengthen the quality management system, and raise the overall level of quality management. The goal was to improve the quality of product, work, and service, so that the enterprise can win in the market competition.

(Nafees Ahmed Memon, Qazi Muhammad Moinuddin Abro and Farida Mugheri, 2011) Improvement in the quality of construction projects is linked with quality management in the project life cycle. Although quality management at every stage of project life cycle is important but the quality management at the design and construction stage contributes significantly on final quality outcome of construction projects. This paper therefore highlights the importance of quality management in the design and construction phase and suggests some proactive measures for the improvement of quality in the design and execution phase of construction projects.

(Ledbetter W.B., 1994) Quality has many meanings; however, for projects, conformance to established requirement has relevance and clarity. This paper explains that the quality performance efforts are tracked using the quality performance management system (QPMS). QPMS tracks labor costs in three main categories i.e normal work, quality management work (prevention and appraisal) and rework (deviation correction). The cost of quality is the sum of quality management and rework. The paper also suggests that QPMS is found to promote awareness and improve the understanding of the quality process, facilitate

communication, focus management on where quality improvements could be made and reduce the overall cost of quality.

(Tan Chin-Keng and Abdul-Rahman, 2011) The concept of quality management is to ensure efforts to achieve the required level of quality for the product which are well planned and organized. From the perspective of a construction company, quality management in construction projects should mean maintaining the quality of construction works at the required standard so as to obtain customers' satisfaction that would bring long term competitiveness and business survival for the companies. This paper aims preliminarily the practices of quality management, management commitment in quality management and quality management implementation problems in construction projects in the context of Malaysian construction industry. The paper applies semi-structured interview approach with twelve project management practitioners also providing an insight on the state of quality management in construction projects in Malaysia.

(Ashokkumar D., 2014) A significant amount of the budget is spent each year on infrastructure and other development projects. Since the quality outcomes of the projects are not according to required standards, faulty construction takes place. Consequently additional investments are required for removal of defects and maintenance work. A construction project in its life span goes through different phases. Although quality management at every stage of project life cycle is important but the quality management at the execution (construction) stage contributes significantly on final quality outcome of construction projects. This paper mainly focuses the importance and factors that affects the quality management in the execution (construction) phase. The paper also includes visiting of some construction companies and conducts the questionnaire survey, then analyse the difficulties (major factors) and the cost variance due to quality defect in quality management and suggests some proactive measures for the improvement of quality in the execution phase of construction projects.

(Jerald Rounds L., M. and Nai-Yuan Chi, 1985) Traditional approaches to quality control in the construction industry are inadequate and should be replaced with the Total Quality Control concept implemented through the Quality Control (Q.C.) Circle. The evolution of quality control is traced from the nineteenth century to today to explain the decline in quality standards and to illustrate the need for a new approach. Unique characteristics of the construction industry are described as they relate to the Q.C. circle concept. Implementation of this concept will result in higher quality, lower costs, and increased productivity in the construction industry. This paper summarizes a research effort to review the evolution and basic concepts of total quality management

and to apply these concepts to the construction industry through use of the quality control circle. The objective of this paper is to stimulate interest in research. This research could prove beneficial in many ways to the construction industry as it has in the manufacturing industry.

(Abas M., Khattack S.B., Hussain I., Maqsood S., Ahmad I., 2015) Quality is one of the important aspects of all projects. The level of success of construction projects greatly depends on the quality performance. The Pakistan construction sector is facing quality related issues, which lead to ineffective and inefficient projects in terms of cost of overrun, delays and excessive rework. This paper suggests the methods and efforts carried out to scrutinize the factors that have triumphed and adverse effect on the construction projects of Pakistan. The factors were ranked based on chi-square and weighted mean statistical analysis.

#### 4. Research Methodology

All related data are collected from „Irrigation Projects and Water Resource Investigation Circle, Amravati, Water Resource Department, Government of Maharashtra. All irrigation projects are situated in Amravati and one in Akola district. Total seven (07) projects were visited, among which six (06) were situated in Amravati district and one in Akola district. Out of these two (02) were medium projects, two (02) were larger minor projects and three (03) were minor projects and all are under construction. Major projects comprises greater than 10,000 Ha, medium projects comprises greater than 2000 Ha, larger minor projects comprises 600- 2000 Ha and minor projects comprises 250- 600 Ha.

Data Analysis:

The data collected were analyzed using the relative importance index technique. Relative Importance Index (RII) method helps to determine the relative importance of the various factors. The Likart scale was used ranging from 1 (not important), 2 (low important), 3 (moderately important), 4 (important), 5 (very important) was adopted. The relative importance index was calculated by the formula shown below.

Relative importance index (%)

$$RII = \frac{5(n_5) + 4(n_4) + 3(n_3) + 2(n_2) + n_1}{5(n_1 + n_2 + n_3 + n_4 + n_5)} \times 100$$

Where n1, n2, n3, n4, and n5 = the number of respondents who selected: 1, for not important; 2, low important; 3, for moderately important; 4, for important; and 5, for very important respectively.

**Table 1:** Framework of factors affecting quality management

<i>Sr. No</i>	<i>Groups</i>	<i>Factors/Variables</i>
1	General	Preparation of specification chart
2		Preparation of tender papers
3		Preparation of field visit registers
4		Availability of specification chart, tender papers and field visit registers at site
5		Execution of monthly work components as per formulated time and specification
6		Rectification of sufficient tests taken (if any) as per time schedule
7		Installation of instruments required
8		Maintenance and availability of plot register
9		Frequent visiting of QC Exe. Engr and QC SDE
10		Proper controlling on field by JE, SE etc
11		Maintenance of registers regarding results
12		Contractors laboratory
13		Pending testing charges
14		Compliance of inspection notes
15		Implementation of new techniques and methods for overall execution
16	Materials and equipments	Procurement of materials and equipments as per IS codes and specification
17		Material procurement from desired source
18		Controlled inspection on material handling/transportation/ delivering
19		Testing and stacking of material in proper places
20		Acquiring proper and adequate equipments for construction
21		Maintenance of equipments/instruments with control on stacking
22		Testing done to judge the equipments/instruments in working condition
23		Check on tests results and rectification as per IS codes and specification
24	Management	Supportive top management
25		Availability of resourceful project managers/project
26		Effectiveness of the project management in improving schedule, cost and quality of the construction output
27		Implementing an effective quality assurance and control programme
28		Achievements of goals set by the organization
29		Providing training to staff to enable them to perform their roles
30		Adopting latest project execution techniques
31		Regular and systematic evaluation for operational staff
32		Award system by the organization to show appreciation for good work
33		Proper selection of projects/type of projects (keeping in mind political, environmental, technical and social issues)
34		Regular and systematic evaluation for administrative staffs
35		Proper selection of clients
36		Flexibility of working hours
37	Others	Designs and drawings as per scheduled time period
38		Funding
39		Land acquisition
40		Forest clearance
41		Rehabilitation
42		Local oppose

## 5. Results and Discussion

From Relative Importance Index techniques (RII) ranking of factors which affect quality management were worked out. Indications were given by the respondents for each of the factors.

A total of 48 questionnaires was responded out of 90 questionnaire issued. The respondents were deputy engineer, sub-divisional engineer, sectional engineer, civil engineering assistant, project manager, contractor, site engineer, site supervisor. Following table gives this ranking.



**Table 2:** Ranking of factors affecting quality management by Relative Importance Index (RII) Technique.

<i>Sr. No</i>	<i>Groups</i>	<i>Factors/Variables</i>	<i>RII (%)</i>	<i>Ranks</i>
1	General	Preparation of specification chart	66.25	15
2		Preparation of tender papers	63.75	18
3		Preparation of field visit registers	63.33	19
4		Availability of specification chart, tender papers and field visit registers at site	64.17	17
5		Execution of monthly work components as per formulated time and specification	27.50	36
6		Rectification of sufficient tests taken (if any) as per time schedule	35.83	34
7		Installation of instruments required	73.75	9
8		Maintenance and availability of plot register	34.58	35
9		Frequent visiting of QC Exe.Engr and QC SDE	64.17	17
10		Proper controlling on field by JE, SE etc	82.92	3
11		Maintenance of registers regarding results	90.00	2
12		Contractors laboratory	90.83	1
13		Pending testing charges	41.67	32
14		Compliance of inspection notes	47.50	30
15		Implementation of new techniques and methods for overall execution	43.75	31
16	Materials and Equipments	Procurement of materials and equipments as per IS codes and specification	64.58	16
17		Material procurement from desired source	64.17	17
18		Controlled inspection on material handling/transportation/ delivering	70.42	12
19		Testing and stacking of material in proper places	77.08	6
20		Acquiring proper and adequate equipments for construction	67.92	14
21		Maintenance of equipments/instruments with control on stacking	72.92	10
22		Testing done to judge the equipments/instruments in working condition	77.50	5
23		Check on tests results and rectification as per IS codes and specification	69.17	13
24		Supportive top management	62.50	20
25		Availability of resourceful project managers/project	62.08	21
26		Effectiveness of the project management in improving schedule, cost and quality of the construction output	75.00	8
27		Implementing an effective quality assurance and control programme	72.50	11
28		Achievements of goals set by the organization	63.75	18
29		Providing training to staff to enable them to perform their roles	50.00	29
30		Adopting latest project execution techniques	63.33	19
31		Regular and systematic evaluation for operational staff	58.75	24
32		Award system by the organization to show appreciation for good work	56.67	25
33		Proper selection of projects/type of projects (keeping in mind political, environmental, technical and social issues)	63.33	19
34		Regular and systematic evaluation for administrative staffs	61.25	23
35		Proper selection of clients	39.58	33
36		Flexibility of working hours	79.17	4

	Management			
37	Others	Designs and drawings as per scheduled time period	76.67	7
38		Funding	58.75	24
39		Land acquisition	61.67	22
40		Forest clearance	55.42	26
41		Rehabilitation	54.58	27
42		Local oppose	53.33	28

## 6. Other Recommendations

From all the results and discussions, it can be concluded that the terms quality assurance, quality planning, total quality management, quality systems, quality control, quality management was achieved in the projects in which product, processes, persons involved, department and organization have met its quality requirements as per specifications and norms.

All the factors give the importance of proper quality management in the irrigation industry. The personnel included in the industry should concentrate in their efforts on eliminating the factors that affects delay in construction so as to achieve quality improvement.

As Amravati falls under saline track, ground water cannot be used for irrigation works; hence only mode of water is rainwater. Due to these projects the problem of drinking water and irrigation works can be eliminated, industrial supply can be enhanced, irrigation potential is increased, power generation industry is developed, fishery industry is developed, agriculture industry is developed, socio-economic development gets enhance in country, due to all the above reasons, the GDP of country can be increased.

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