Quality Assurance Management Practices in Public Building Construction Projects: The Case of Bahir Dar City

Abrham Zegeye Getie, Bahiru Bewket Mitikie, and Solomon Melaku Belay

Contents

A. Z. Getie (✉)
University of Gondar, Department of Construction Technology and Management, Institute of Technology, Gondar, Ethiopia

Faculty of Civil and Water Resources Engineering, Bahir Dar Institute of Technology, Bahir Dar University, Bahir Dar, Ethiopia

B. B. Mitikie
Adama Science & Technology University, Department of Civil Engineering, Adama, Ethiopia

S. M. Belay
Faculty of Civil and Water Resources Engineering, Bahir Dar Institute of Technology, Bahir Dar University, Bahir Dar, Ethiopia

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1 Introduction

The construction industry is vital for the development of any nation. It is a large, advanced industry and it has many important links to the rest of the economy. The importance of the construction industry to the economy can be measured by its contribution to the Gross Domestic Product, its contribution to investment, and the amount of labor employed [1]. In other ways, the stages of the economic development of any nation can be measured by the development of physical infrastructures such as roads, bridges, and buildings. Construction project progress involves several parties, several methods, different sections or pieces and stages of work, and a great deal of input from both the public and private sectors, with the major goal being to successfully implement the project [2].

The common assessment of the success of construction projects is that they are delivered on time, to budget, to technical specifications, and meet client satisfaction [3].

Currently, the construction industry has widely complained about the low quality of delivery of construction projects, both the finished product quality and the process used during the project design and construction stages [1]. Quality-related problems during construction can be to do with the functioning lifecycle of the project. To a contractor, nonconformance can yield penalties as well as cost and time burdens for re-work, which can convert into productivity loss [4]. The objective of this study was to investigate quality assurance (QA) and management practices in public construction projects in the case of Bahir Dar City.

In general, when the construction industry is compared with other sectors of the economy within their own countries, as well as with their counterparts elsewhere, productivity, quality problems, safety and health, and environmental factors affect the performance of construction projects [5].

The research was focused on current and existing QA methods, techniques, and practices in the Bahir Dar construction projects; identifying major factors that affect QA management practices in the public construction project in the case of Bahir Dar, exploring mechanisms to improve QA management practices in public construction projects in Bahir Dar; and to develop a QA management framework for a public construction project.

1.1 Definition of Quality

Implementation of QA in the construction industry has been mainly client led; the basic reason is that realizing enforcement of the contract in law after great nonconformance has already happened cannot reverse any damage already done [6]. Customers in both the private and public sectors are looking for confidence that could be provided by a business with an effective (or even certified) quality management system, and that had begun to maintain an effective quality system as a prerequisite for tendering. The basis of completion for business is shifting from "price only" to a combination of price and quality [7].

According to Orji et al. [8], quality control and QA have much in common. Each evaluates performance. Each compares performance with goals. Each different QA system cannot guarantee with absolute certainty the production of quality products, but makes this more likely [9].

1.2 Quality Assurance

Quality assurance is the planned and systematic preventive activity that increases productivity by placing importance on products and services [10]. As noted by Oyedele et al. [10], QA highlights defect prevention, focuses on the prevention of the production of nonconforming products to provide the confidence of organizational outputs, and ensures customer satisfaction.

Thus, QA is done by a set of activities before the manufacturing process of products and services to control quality at all stages of production. It is necessary to provide confidence in organization outputs to maintain close links with customers [11].

Within this broad context, QA involves continual evaluation of the activities of planning, design, development of plans and specifications, promotion and awarding of contracts, construction, maintenance, and the interactions of these activities [12].

1.3 Benefits of Quality Assurance

Quality assurance has become a basic part of most construction industries. The first benefit is that it helps in understanding the desires and expectations of the client [13]. Second, QA has increased the effectiveness of the construction industry. It requires the construction industries to give proper training to their employees so that they can understand their jobs better as well as be trained on the new technology to work and perform better [9, 14].

1.4 Factors Affecting Project Quality Assurance

Birhanu and Daniel [15] thus identified the root causes or factors that affect the construction project quality. The finding showed that the quality of work management practices depended first on the leadership problem, the weakness of policy and strategy, inefficient resource management, efficient process management, limited focus on customers' requirements, and weak business performance.

Construction output depends on the construction facility (project). The main parties involved in the construction phase are (1) the owner, (2) the designer (3) the general contractor, (4) the material supplier, (5) the owner's site team, and (6) the contractor's site team. The elements (factors) affecting QA of the construction process are the components of both construction inputs and construction processing.

1.5 Mechanisms to Improve Project Quality Assurance

According to Marasini and Quinnell [7], to minimize or reduce the factors that affect project QA in construction the following mechanisms should be considered for each project. The mechanisms were ranked as (1) Management commitment, (2) Communication between managers and employees, (3) Employee involvement, (4) Detailed and logical work program, (5) Regular inspection and audit of the quality report, (6) Training and education of team members, (7) Review/analysis used to improve performance, (8) Well-defined roles and responsibilities of project participants.

2 Research Methodology

2.1 Research Design

The research design was comprehensive; the comprehensive design uses a both descriptive and an explanatory research design. To undertake this research, a mixed approach was adopted. The mixed approach used for the study was concurrent with that being used both quantitatively and qualitatively at the same time for stakeholders.

2.2 Sampling Technique

The sampling technique was used in a nonrandom sampling technique. Because the population was known and the number in the population is less than 50, then the whole population and the purposive or judgmental types of sampling technique was used to select the public building projects [16].

2.3 Data Collection Tools/Instruments

In collecting the necessary data, self-administered questionnaires and interviews were used. Primary data were collected through questionnaires and interviews, whereas secondary data were collected through archival documents/literature (reports, research, textbooks). Then, the researcher took the sample for 26 projects and for each project one client, one consultant, one contractor, and the regulatory body for each project, with a total of 104 samples taken.

2.4 Data Measurement

Based on the Likert scale the researcher had the following rating scale for measuring the techniques for implementing QA (strongly disagree, I do not agree, neutral, agree, and strongly agree). For data related to major factors affecting QA management practices in the public building project the rating scale was very low importance, low importance, medium importance, important, very important) and for the mechanisms to improve QA management practices the rating scale was lowest, lower, high, higher, and highest) and based on a scale of 1 to 5 respectively, as shown in the Table 1 below.

2.5 Data Analysis

The relative importance index (RII) method was used to determine and rank the factors that affect QA management practices in public buildings, the mechanisms to improve QA and management practices, and QA management methods and practices in construction projects. All data were analyzed by using MS-Excel and SPSS software.

Table 1 Technique for implementing quality assurance management practices

		Level of importance	
No	Techniques	RII	Rank
1	Project quality control management	0.775	1
2	Daily report	0.727	9
3	Weekly or bi-weekly site report	0.7375	8
4	Work method statement	0.7567	7
5	Inspection(quality audit/management and process)	0.766	3
6	Laboratory experiment	0.756	6
7	Direct supervision	0.775	1
8	Involvement of workforce	0.725	10
9	Stakeholders' communication	0.762	5
10	Following instructions, standards, and codes	0.7666	3

3 Result and Discussion

3.1 *Current QA Management Practices in Public Construction Projects*

To examine this basic question the respondent's background, data acquisition method, companies' work experience with QA, and organization's perception of QA and management practices were presented.

From Bahir Dar public project profile from Fig. 1, the analysis chart shows that the respondent's status within their company was director/principal partner in 47.91%, senior staff in 23.95%, regulatory body in 23.95%, associate partner in 2.08%, and the remaining 2.08% had another status.

From Bahir Dar public project profile, Fig. 2 shows the respondent's project types they normally undertake: institutional buildings in 35.41%, office accommodation in 31.25%, industrial buildings in 17.7%, 7.29%, and large-scale residential houses in 4.16%.

From Bahir Dar public project profile, Fig. 3 also shows that the position of respondents was project manager in 41.67%, regulatory body in 22.91%, manager in 17.71%, and resident engineer in 9.375%.

From the chart in Fig. 3, the respondents were the manager, regulatory body, vice manager, project manager, site engineer, and a resident engineer. Since the researcher distributes to the main respondents but the above respondents are also the representatives of the contractor, consultant, contractor, and regulatory body stakeholders.

From Fig. 4, it could be seen that the respondent's general perception of QA was that 56% said that QA was a contractual requirement, 32% said that it was a management approach, and the other 8% said that it was a marketing tool.

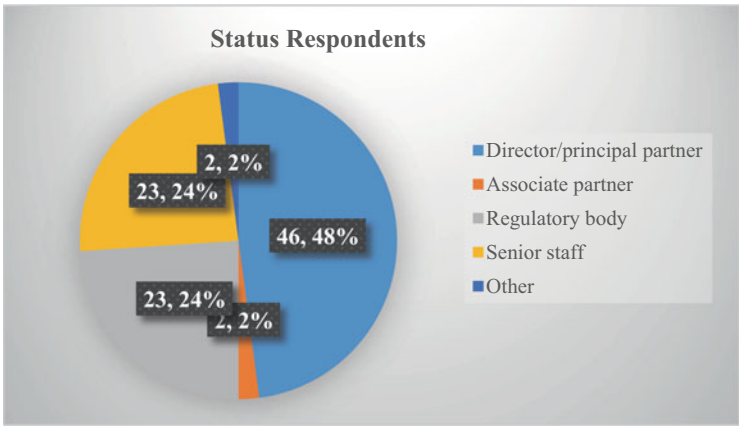

Fig. 1 General status of respondents

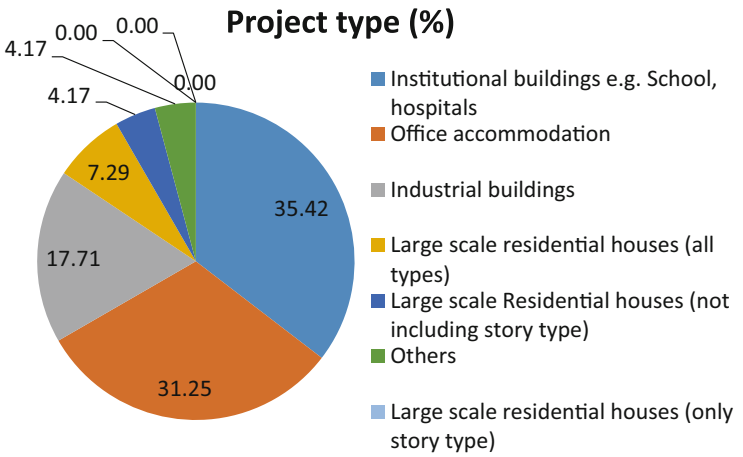

Fig. 2 Respondents' project type

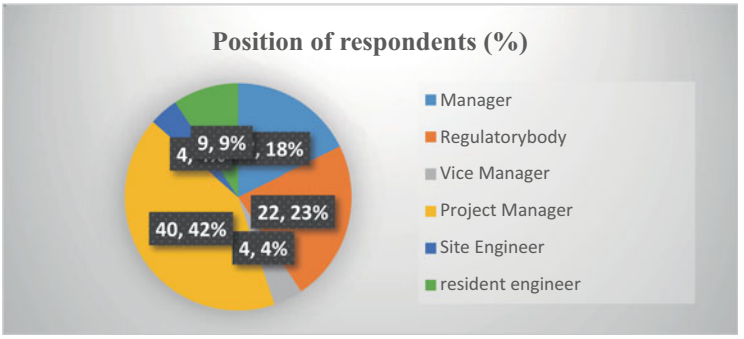

Fig. 3 Positions of respondents

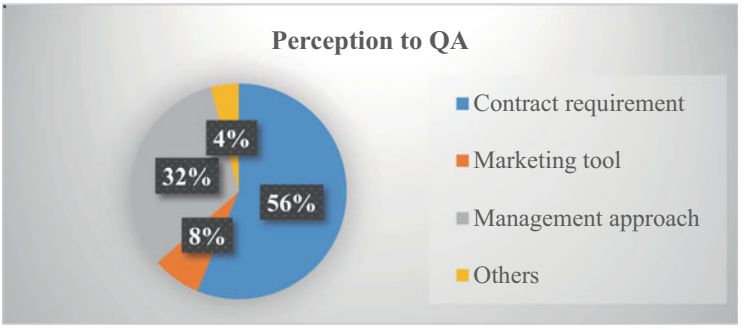

Fig. 4 Pie chart for respondent's perception of quality assurance

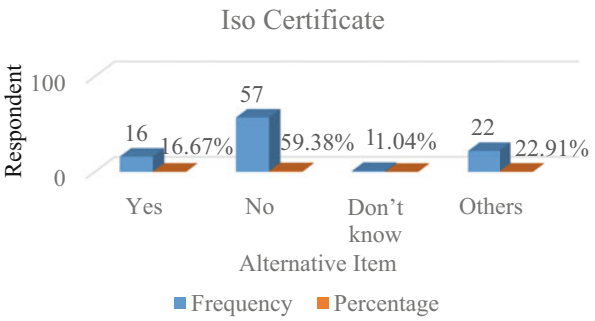

Fig. 5 Projects that have an International Organization for Standardization certificate

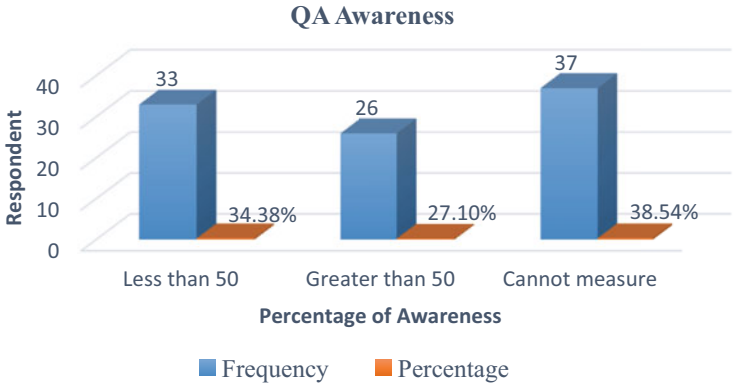

Fig. 6 Employer's awareness of quality assurance in their project

In Fig. 5, 59.375% of respondents said that no International Organization for Standardization (ISO) certificate was given by the regulatory bodies of their company and only 16.67% of respondents have obtained an ISO certificate in different years.

As shown in Fig. 6, 34.375% of respondents said that the percentage of employees who are aware of the importance of QA was less than 50% and only 27.1% of respondents said that the percentage of employees who are aware of the importance of QA was greater than 50%. The other 38.54% were unable to measure this.

3.2 Techniques Used for QA Management Practice

Techniques used for QA management practice are presented in Table 1. As shown in Table 1, the techniques for implementing QA management practices were ranked as project quality control management, inspection, direct supervision, following instructions, standards, and codes. Laboratory experiments in quality management rank in 6, with 1 up to 5 in the RII.

Table 2 Major factors of QA with their level of influence based on relative importance index (RII) value

No.	Major quality assurance factors	Level of importance	
		RII	Rank
1	Project (type, maturity, and complexity)	0.77	5
2	Design	0.82	2
3	Contract (license of consultant/contractor, method and agreement)	0.825	1
4	Material	0.795	4
5	Labor (quality/experience)	0.747	9
6	Equipment	0.760	7
7	Subcontractor	0.714	14
8	Site layout	0.733	12
9	Systems (quality control, cost control, safety program)	0.764	6
10	Site staff	0.75	8
11	Execution (continuous, supervision, using shop drawings)	0.80	3
12	Financial issues (resources availability)	0.743	10
13	Size of firm or owner (public, private)	0.739	11
14	Organizational factors (environmental, political, economic)	0.73	13

3.3 Major Factors That Affect QA Management Practices

The major factors that affect QA management practices are shown in Table 2. The level of influence of factors with the RII value of major elements by consultant, client, contractor, and regulatory body participating in Bahir Dar public construction projects executed from 2007 to 2012 Ethiopian Calendar (E.C).

As shown in Table 2, the major factors that affect QA management practice analyzed by respondents were contract, design, execution (continuous supervision, using shop drawings), material, and systems (quality control, cost control, safety program) taking the first ranks up to five with an RII value.

3.4 Mechanisms to Improve QA Management Practices

As shown in Table 3, with regard to the mechanisms to improve construction QA management practices, respondents argue that communication between managers and employers, incentives for good performance, avoiding damaged and low-quality materials, satisfaction of contract specifications, and following efficient safety programs were ranked highest.

Table 3 Mechanisms to improve QA with the level of importance by the contractor, client, regulatory body, and consultant with relative importance index (RII) value

No.	Mechanisms to improve QA	RII	Rank
1	Employee involvement	0.722	17
2	Written program or policy	0.716	18
3	Criteria (pre-qualification in the bidding process)	0.733	16
4	Regular meetings	0.764	9
5	Management commitment	0.802	3
6	Skilled workforce	0.804	2
7	Communication between managers and employers	0.83	1
8	Incentives for good performance	0.802	3
9	Regular inspection and audits	0.795	6
10	Review/analysis used to improve performance	0.762	10
11	Clearly defined goals and objectives	0.747	13
12	Avoid complexity of designs	0.760	11
13	Reduce miscommunication between teams	0.754	12
14	Avoid damaged and low-quality materials	0.797	5
15	Well-defined roles and responsibilities	0.766	8
16	Adequate training and education on QA practices	0.747	13
17	Scope creep (reducing)	0.741	15
18	Satisfaction of contract specifications	0.775	7
19	Reward scheme for innovative work	0.697	20
20	Follow efficient safety programs	0.716	18

3.5 Summary of Interview

A. Summary of Contractor's Interview
When analyzing the interview conducted with the contractor, it is mentioned that workmanship quality in the public construction project is not up to standard and that it is dropping, considerably taking into account unrealistic periods and tight budgets allocated by the government as well as procurement systems being a major threat ultimately to poor workmanship quality. To improve, these threats must be looked at, especially procurement systems, which play a major role when it comes to factors such as time, cost, and more so quality pressures exerted by the government such as time constraints and financial support, all make a major contribution toward poor workmanship in the construction process for the sake of QA. In addition, the contractors stress that benchmarking mechanisms are critical in achieving a good quality of workmanship and construction with intended QA standards.

B. Analysis of Interview by the Designer
The designer defined that quality and QA are closely related to each other. It is mentioned that the word quality is interpreted very differently by each individual based on their perspective. From the designer's perspective, the word quality looking at a variety of public construction projects means a project

that is fit to live in and serves its purpose. In addition to this, from the designer's perspective, the expression QA refers to or tells of a policy or promise put in place to achieve a quality product. The designer further mentioned that there are certain factors that the designer ascertains in public construction projects in Bahir Dar. For example, governments' inconsistency when it comes to decision-making with regard to the face that public constructions represent to the public and thus to the world.

C. the Regulatory Body

Based on the interview carried out with the regulatory body, it was mentioned that public construction projects and the problems they face within Bahir Dar have not yet been adequately mastered. Owing to the project buildup, land availability becomes a problem, causing conflict between community members. The regulatory body also adds that the government has set unrealistic periods for eliminating or improving the buildup at present.

3.6 Results of the Selected Case Studies

The case studies as shown in Table 4 were the three selected projects. The data have been collected from archival documents, discussions with participants on the project site, and monthly progress reports from contractors and consultants.

Table 4 Summary of projects from the quality assurance perspective

	Projects		
Criteria	Project A	Project B	Project C
Problem of QA	Availability of quality of materials Conformance to specifications Unavailability of equipment Speed of delivering the project to the owner The contractor has not provided enough materials for the work activity needed The contractor's poor management has made the construction progress behind schedule Design changes happen after 20% of work has been executed	Conformance to specification Unavailability of quality materials Sequencing of work according to the schedule Number of those claims submitted from the contractor The performance of the contractors is tolerable The machinery and manpower on the site are not sufficient and the material on the site is not satisfactory The contractor is not on the site for a successive month	Unavailability of workmanship Cash flow manpower Falling of materials from the building on people moving near the site The contractor has not provided enough materials for the work activity needed The contractor has not mobilized enough manpower to the site Rejection of work Change in the scope of work Material escalation Inaccuracy of the data and methods

3.7 Discussion on the Findings

The current QA and management practices, methods, and techniques were the first basic question for the researcher. Therefore, the current construction management practices based on findings show that overall organizations do not collect data to measure the performance of QA

In QA management, practice quality implementation and customer satisfaction have a positive relationship, hence the need to rate suppliers or contractors based on QA performance. Therefore, the practice indicated for the overall organization was based on QA performance. The other finding was that suppliers or contractors pay for the defects themselves. The researchers showed the organization's perception of QA management practices was viewed as a contractual practice and a management approach.

The researchers found that among the top or major factors that affect QA management practice in public construction contracts take the first rank. This implies that the contract type and method affect the project QA.

The second major factor that affects QA based on the findings indicated is the design, material, system (quality control, cost control, safety program), and execution (continuous supervision, use of shop drawings). The other equipment, site staff, financial issues, labor and project type, and complexity take the highest rank following the first and the second major factors that affect QA and management practices in public construction projects.

On the other hand, Oni et al. [17] identified the major factors affecting construction QA to be design and planning during the pre-construction phase, developing and improving QA and control systems, the financial level and standard of living of employees, the accuracy of cost estimation, the proper classification of contractors, consultants, and projects, and employees' consciousness.

Another researcher found that the top five major factors that affect QA management practice [9] are design, which includes all things related to design – coming from the designer and/or the owner side; contract: the prime contract between the owner and the contractor; materials: including all things related to raw materials and their suppliers; labor: including all the main working labor in the project; and equipment: including the main working equipment in the project.

The researcher's basic question to answer is what are the most important mechanisms to improve the QA management practices? The first ranks by the organizations were (1) Communication between managers and employers, (2) Incentives for good performances, (3) Avoiding damaged and low-quality materials, (4) The satisfaction of contract specifications, and (5) Following efficient safety program ranks, which had a high RII value.

On the other hand, good management commitment, review, or analysis used to improve performance, avoid the complexity of designs, reduce miscommunication between teams, and clearly defined goals and objectives were ranked from their RII value with respect to the above first and second mechanisms. In addition to this, according to Fikreab et al. [6] the top mechanisms to improve QA management

practices were ranked as management commitment; communication between managers and employees; employee involvement; detailed and logical work program; regular inspection and audit of the quality report; and training and education of team members.

3.8 Construction QA and Management Framework

One of the basic methods of analyzing the construction QA and management framework for the researcher is first to identify the major QA techniques, the major factors that affect QA management, and the improving mechanisms for QA management for the construction of public building projects.

Figure 7 shows the findings of the researcher that the QA management framework demonstrates the integration of factors, techniques, and mechanisms to improve QA in public projects.

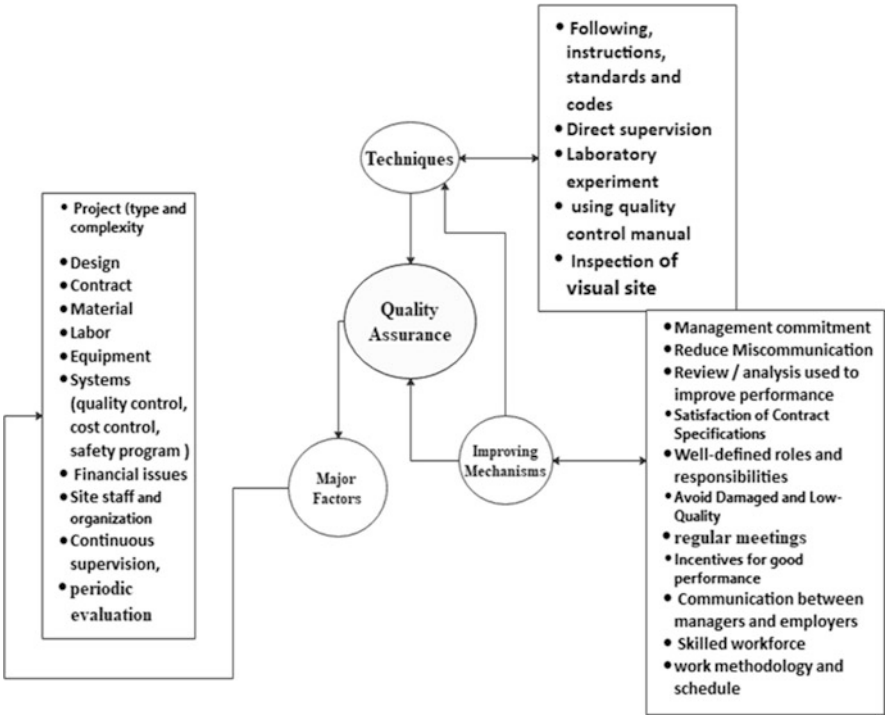

Fig. 7 Revised conceptual frameworks for quality assurance management

4 Conclusion

Generally, current construction management practices in public construction projects from Bahir Dar City show that overall, organizations do not collect data to measure the performance of QA. In addition to this, the researcher concludes that customer satisfaction was measured by the different numbers of complaints that arise. This shows that there was not enough training to ensure customer satisfaction by carrying out good-quality construction.

The major techniques for QA management practices were performing good project quality management, an inspection of site activities, direct supervision, conducting different laboratory experiments, and following appropriate instructions, standards, and codes, ranking from 1 up to 5 and with high relative importance compared with other QA management techniques.

The researcher also concludes that the major factors that affect QA management practice in a public project, the construction contract takes the first rank among others. This implies that the contract type and method affect the project QA, whereas the second major factor that affects the quality assurance indicated that the design, material, system (quality control, cost control, safety program), and execution (continuous supervision, use of shop drawings) have ranked been by the RII value.

The most important mechanisms for improving the QA management practices are ranked as (1) Communication between managers and employers, (2) Incentives for good performances, (3) Avoiding damaged and low-quality materials, (4) The satisfaction of contract specifications, and (5) Following an efficient safety program was ranked as the first with a high RII value.

Finally, the researcher recommends the following issues for future researchers and work: Develop a model framework for QA and management practice for public construction projects; comparative study of Ethiopian construction should be trained from other countries with regard to quality control and QA with different international standards, codes, and techniques; and evaluate major stakeholders' performance based on QA and management practices.

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