

RANKING OF KEY QUALITY FACTORS IN THE INDIAN CONSTRUCTION INDUSTRY

S.Shanmugapriya¹, K.Subramanian²

¹ Assistant Professor, Department of Civil Engineering, Coimbatore Institute of Technology, Tamilnadu, India

² Professor and Head, Department of Civil Engineering, Coimbatore Institute of Technology, Tamilnadu, India

Abstract – *Quality being one of the critical success factors in the construction industry is meeting the predetermined requirements and specifications. It is a business strategy for winning over customers from the competitors. Successful organizations design, deploy and demonstrate to their customers appropriate management system to deliver quality product and services. With tremendous pressure from the market and the competitors as well as increasing customer's requirements, the Indian construction firms are forced to improve the quality of their products and implement effective quality management systems to survive in the competition. This paper presents a research study that aims at ranking key quality factors based on the European Foundation for Quality Management (EFQM) framework in the Indian construction industry. A structured questionnaire for the survey was developed based on the five enablers of EFQM framework, namely leadership, partnership and resources, policy and strategy, people and process to evaluate the key factors influencing quality in the Indian construction industry and then distributed to the clients, consultants and contractors. Descriptive analysis using the Relative Importance Index was performed for ranking the quality factors as perceived by the respondents based on its critical importance. The result of the survey revealed that top five factors influencing quality are conformance to codes and standards, quality documentation, satisfying customer's needs, updating and sharing of knowledge by the leaders and planning and managing human resources. It is recommended that the construction organization should give priority to these key factors for improving quality in the construction projects.*

Key Words: Construction, Quality, EFQM, Relative Importance Index

1. INTRODUCTION

Quality is an important issue in the Indian construction industry for sustainability and customer satisfaction. Quality and quality management systems are the research topics which have been receiving attention in developing countries. Modern construction projects are complex in nature and subjected to frequent quality failures or non-conformance to quality resulting in increase in project cost, decrease in the efficiency of the project and affecting the overall performance of the construction industry. In developing countries like India, quality did not reach the sufficient level of acceptance and face many obstacles due to the complex nature of the construction industry. Quality is considered as a discriminating factor in the Indian construction industry and it is characterized by poor quality. The achievement of quality is critical in construction projects, as poor quality results in rework and dissatisfaction of client, contractor, designer and consultant. Implementation of effective quality management systems results in better control of suppliers and enables the contractors to meet the client requirements. It increases productivity, profitability and market share [1]. Quality, cost and timeliness are viewed by construction managers as three views in conflict with each other, thus making quality often compromised to save time and cost. Among the three aspects of quality triangle, most of the time, the project management is attending to time and cost compliances, construction quality is ignored in the Indian construction industry. There should be a balance amongst three aspects because they define the project scope. However, quality may be the first of those components to be overlooked in favour of increased cost savings and time reductions [2]. Many developed countries have applied comprehensive quality management systems to manage quality in the construction projects. International studies and research have emphasized the need of improving quality performance to reduce the defects, reworks and deliver a better quality product to the customers. The need for implementing effective quality management systems has been spreading widely in the Indian construction industry. To bring about the changes in the industry and

to achieve better understanding of quality management systems, the organizations must identify the factors that contribute to the quality and develop the framework that can be used as self-assessment tools for improvement. Quality awards like the European Foundation for Quality Management (EFQM) excellence model are used for quality improvement and the model takes into consideration all features and mechanism of the organization, including leadership, partnership and resources, policy and strategy, people and process. Hence, in this study the five enablers of EFQM framework are used as a guide to identify the key factors influencing quality in the Indian construction industry.

2. RESEARCH METHOD

A structured questionnaire survey is designed to identify the factors influencing quality in the Indian construction industry. Questionnaire for the survey consists of two parts with the first part designed to gather information on the organization's profile and personal information of the respondent. The second part of the questionnaire includes forty nine statements that tend to influence the quality in construction industry under five constructs, i.e., leadership, people, partnership & resources, policy & strategy, and process. Each statement is designed to elicit the respondents' opinions on the different attributes in the context of quality enhancement using a 5-point Likert scale, with point 1 representing very little effect, point 2 representing little effect, point 3 representing average effect, point 4 representing high effect and point 5 representing the very high effect. This approach enables the evaluation of the respondent's perception and commitment towards enhancement of quality. A Questionnaire has been distributed to about 150 respondents, including client, contractor and consultant of the Indian construction industry and got the filled questionnaire back from 113 respondents at a response rate of about 75%. Descriptive statistics are used to analyze the raw data collected from the client, contractor and consultant and study their attitude towards these key quality factors in the construction industry. The Relative Importance Index (RII) method is used for the ranking of attributes in terms of their relative importance as perceived by the respondents. It is a commonly used method of construction where a structured questionnaire contains the measurements that are subjective in nature. The mean item score for each indicator within constructs is calculated to obtain the Relative Importance Index (RII) as follows

$$RII = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5N}$$

Where, W is the weighting given to each factor by the respondent ranging from 1 to 5, n_1 is the number of respondents stating very little effect, n_2 is the number of respondents stating little effect, n_3 is the number of respondents stating average effect, n_4 is the number of respondents stating high effect, n_5 is the number of respondents stating a very high effect and A is the highest weight.

2.1 Factors influencing quality

The extensive review of quality literatures yielded the following indicators for the five constructs (enablers) such as leadership, people, policy and strategy, partnership and resources and process that influence the goals of achieving quality performance.

2.1.1 Leadership:

Leadership is the first criterion of the European Foundation for Quality Management (EFQM) Excellence Model, which is used by an estimated 20,000 organizations across Europe. A key aspect influencing quality in an organization is leadership, which links the various components of the quality system. Project manager's competence, top management support and interaction between project's participants are external contributors enhancing project quality performance from its existing level while owner's competence is an internal contributor as owners tend to retain the quality performance at the existing level itself [2]. Leadership is considered as the most influential element for quality performance improvement in construction industry and 10 attributes are included under this enabler as sub factors – Role model for cultural excellence in quality (L1), Responsible for quality performance (L2), Specifying quality objectives (L3), Commitment (L4), Encouraging the employees (L5), Acknowledgement and rewarding employees (L6), Collaborate employees in quality training (L7), Updating the knowledge (L8), Plan detailing the different stages of changes in project (L9) and Measure and review the effectiveness of quality (L10).

2.1.2 People

People enabler emphasizes how well the firms are able to utilize the full potential of its most valuable resource and asset, its people. Matlhape and Lessing [3] stated that an important component of introducing quality management systems in an organization is training, development, and empowerment of employees, as well as confirming that quality is not only for shareholder value creation, but that it becomes a personal goal for them. The EFQM Model revealed that

competencies and skill of the employees are to be continuously developed to result in quality improvement. The firms have to create a culture that value their people and result in the achievement of personal and organizational goals. They have to motivate people with awards and recognition, encouraging communication and enabling the people to use their knowledge and skill for performance improvement of the organization. In high-performance organizations, people are enabled to do their best work. They have the adequate tools, standards, policies, and procedures. This people enabler consists of eleven attributes – Planning and managing of peoples resources (PPL1), Incentives and awards (PPL2), Knowing up of quality as their responsibility by project participants (PPL3), Recruitment depending upon their skills and experience (PPL4), Two way communication (PPL5), People are responsible for end results of the quality (PPL6), Giving the opportunity to implement solutions(PPL7), Welfare program (PPL8), Motivation systems (PPL9), Training (PPL10), Suggestions, feedback and complaint system(PPL11).

2.1.3 Policy and Strategy enabler

Policy and strategy enabler describes how policy and strategies are formulated and developed in to plan and actions. The development of policies and strategies is the key for determining quality initiatives in the organization. The firms seeking to establish a quality system have to define its quality policy. The overall business plan of the most successful total quality management is incorporated with the quality goals. Oakland [4] described the need and requirements of the sound quality policy, together with the organization and facilities to implement total quality management. Sureshchandar et al., [5] emphasized quality policy should be used as standard for practice to set the priorities. In the absence of formal policies and strategies, people go for developing their own, individual and differing standard practices. 9 attributes are included under this enabler in conceptual framework – Satisfying the needs and expectation of the stakeholders (PS1), Periodic review and update of policies (PS2), Benchmarking techniques (PS3), Swot Analysis (PS4), Specific and measurable objectives for quality policies (PS5), Systematic measurement of quality and non-quality cost (PS6), Systematic procedures to plan, evaluate and control project goal achievements (PS7), Systematic procedures based on information from performance measurement of projects, research, learning and external related activities(PS8), Systematic assessment of effectiveness of projects (PS9).

2.1.4 Partnership and Resources enabler

Partnership and resources enabler emphasize how the organization manages the resources, including external resources efficiently and effectively. The EFQM model states that excellent and outstanding organizations plan and manage external partnerships, suppliers and internal resources in order to support the policy and strategy and effective operation of the process. The present and future needs of the organization should be balanced during planning and managing partnership and resources. Isik et al., [6] defined the firm's resources are tangible and intangible assets including financial resources, technical competencies, leadership characteristics and experience and these are required for developing and implementing strategies. Partners encourage the external focus of the organization and bring in necessary expertise for the good functioning of the organization. Ten attributes are included under this enabler - Long term relations with the suppliers (PRS1), Suppliers help in providing technical assistance (PRS2), Quality agreement with the suppliers (PRS3), Quality documentation (PRS4), Specifying right quantity of materials(PRS5), Allocation of financial resources to meet the actual budgeted cost (PRS6), Proper allocation of equipment and materials (PRS7), Using technology with higher operational efficiency (PRS8), Focus on research and development (PRS9), Site quality inspection of materials (PRS10).

2.1.5 Process enabler

Juran and Godfrey [7] revealed that the key reason for the gap between quality improvement expectations of the firm and the recognition of the benefits is the absence of an effective quality planning process. The quality planning is identified as one of the significant phases of the firm's quality planning process and it is emphasized in Total Quality Management (TQM) and the International Standardization of Organisation (ISO). Leonard and McAdam[8] highlighted to integrate quality planning and strategic planning in the firms to avoid conflict between the two plans. The EFQM model stated that excellent organizations develop and improve processes to generate increasing value for customers and stakeholders. It is essential for the construction firms have the internal process and procedures for its effective functioning and quality enhancement. Chinda and Mohamed [9] highlighted that process enabler influences the implementation of any framework and enables the firm to achieve the goals. Under this enabler 9 attributes are included-Systematic design and management of process (PRO1), Comprehensive documents (PRO2), Regular assessment of process to bring in change and improvement (PRO3), Using system of indicators to revise the change (PRO4), Efficient behaviour patterns through work process (PRO5),

Improvement of process through innovative techniques (PR06), Satisfying customers' needs (PR07), Improvement of customers relationships (PR08), Conformance to codes and standards (PR09).

3 Results and Discussion

The results of the analysis of the questionnaire with the population characteristics and ranking of quality attributes are presented below.

3.1 Type of respondents

In this study, 54 contractors, 24 consultants, 35 clients participated in the questionnaire survey. The general response rate for contractors, consultants and owners was 48%, 21% and 31%.

3.2 Type of work executed by the respondent's organization

It was observed that 70% of the respondents were involved in building construction projects, 14% of the respondents in industrial building projects and 5 % of the respondents in road and bridge projects and 11% of the respondents in other projects.

Table -1: Overall RII and Ranking of Quality factors

Rank	Description of factors influencing quality	Construct	Overall RII (%)
1	Conformance to codes and standards	Process	83.89
2	Quality documentation	Partnership and resources	83.54
3	Satisfying customers' needs	Process	82.12
4	Updating the knowledge	Leadership	81.95
5	Planning and managing human resources	People	81.59
6	Collaborate employees in quality training	Leadership	80.53
7	Improvement of processes using innovative technique	Process	80.18
7	Improvement of customer relationship	Process	80.18
9	Acknowledgement and rewarding employees	Leadership	80.00
10	Role model for cultural excellence in quality	Leadership	78.94
10	Quality agreement with suppliers	Partnership and resources	78.94
12	Systematic assessment of effectiveness of projects	Policy and strategy	78.76
13	Systematic design and management of process	Process	78.58
14	Knowing up of quality as their responsibilities	People	78.41
14	Recruitment depending upon their skills and experience	People	78.41
16	Comprehensive documents	Process	78.23
16	Responsible for quality performance	Leadership	78.23
16	Commitment	Leadership	78.23
19	Measure and review the effectiveness of quality	Leadership	77.88

3.3. Experience of respondents

It was observed that 16% of the respondent's firm have experience more than 10 years in construction works, 21% of the respondent's firm have experience between 5 to 10 years, 45% of the respondent's firm have experience between 3 to 5 years and 18% of the respondent's firm have experience between 1 to 3 years in the construction works.

3.4 Value of projects executed by the organization

It was observed that only 23.33% of respondents executed projects with cost less than 20 million per year, 25.33% of respondents executed projects with cost ranged from 20 to 30 million and 51.33% of respondents executed projects with cost ranged from more than 30 million per year.

3.5 Ranking of quality factors

The results of ranking relative importance of the factors influencing quality in the Indian construction industry are presented under five constructs namely leadership, people, policy and strategy, partnership and resources and process. Table 1 lists the total results of responses per factor influencing quality in the Indian construction industry.

Rank	Description of factors influencing quality	Construct	Overall RII (%)
19	Training in the principles of quality	People	77.88
19	Incentives and rewards	People	77.88
22	Two way communication	People	77.70
23	Encouraging the employees	Leadership	77.52
24	Site quality inspection of materials	Partnership and resources	77.17
25	Giving the opportunity to implement solutions	People	76.81
26	Planning and detailing the different stages of changes in the project	Leadership	76.46
27	Using technology with higher operational efficiency	Partnership and resources	76.28
28	Specific and measurable objectives for quality policies	Policy and strategy	75.75
28	Long term relations with the suppliers	Partnership and resources	75.75
30	Periodic review and update of policies	Policy and Strategy	75.40
31	Suggestions, feedback and complaint system	People	75.22
31	Specifying quality objectives	Leadership	75.22
31	Systematic procedures based on information from performance measurement of projects, research, learning and external related activities	Policy and Strategy	75.22
31	Specifying right quantity of materials	Partnership and resources	75.22
35	Allocation of financial resources to meet the actual budgeted cost	Partnership and resources	75.04
35	Motivation systems	People	75.04
37	Systematic assessment of the process	Process	74.87
37	Suppliers help in providing technical assistance	Partnership and resources	74.85
39	Proper allocation of equipment and materials	Partnership and resources	74.69
40	Satisfying the needs and expectation of the stakeholders	Policy and strategy	74.51
41	Systematic measurement of quality and non quality cost	Policy and strategy	73.98
42	Focus on research and development	Partnership and resources	73.81
43	Benchmarking Techniques	Policy and strategy	73.27
44	Using a system of indicators to revise the change	Process	73.09
45	Welfare program	People	72.21
46	Systematic procedures based on information from performance measurement	Policy and strategy	71.86
47	People are responsible for the quality and end results of the project	People	71.50
48	Efficient behavior patterns through a work process	Process	70.44
49	SWOT analysis	Policy and strategy	68.67

The respondents ranked the factor “Conformance to codes and standards” as the most important factor influencing quality in the Indian construction industry. It was observed that the first ranked factor is related to process construct with Relative Importance Index equals to 83.89% and the last ranked factor “SWOT analysis” related to policy and strategy construct with Relative Importance Index equals to 68.67%. The perceived effect of each of the forty nine factors investigated on the factors influencing quality in the Indian construction industry is determined.

The first rank factor “Conformance to codes and standards” is in line with the findings by Idrus and Sodangi [10] who recommended establishing specialist construction quality council by the government to serve

as a regulatory body, to ensure conformance to quality standards required in materials, labour skills, equipments, construction methods etc. Quality schemes should involve making the right selection of quality materials, appropriate construction methods to be included as a part of design and ensuring that the design of the project complies with all the applicable codes and regulations as specified in the contract documents. ISO certification helps in improving the quality performance in the construction industry. This international organization for standardization fixes the standards for quality with laying down the procedures and process in the form of documents. This standard can assure that the firms which have obtained the certification, works according to the specified requirement. It provides a systematic approach, aligned with policies, procedures,

record keeping and resources for managing quality work.

The second rank factor "Quality documentation" is consistent with the findings by Patel [11] who mentioned that effective documentation increases the visibility of the quality assurance system. Rezaei et al., [12] concluded that companies looking for quality management system deployment, like ISO 9000 certification, face difficulties in paperwork and documentation. They suggested the use of web-based office automation system to reduce paperwork and documentation problems through IT utilization.

The third rank factor influencing quality is "Satisfying customers needs" is in line with the results by Torbica and Stroh [14] who confirmed that implementation of total quality management is positively related to customer satisfaction. Customer satisfaction is seen as a measurement tool in the improvement of construction quality. Al-Momani [14] investigated service quality in construction delivered by contractors and found that contractors pay very little attention to the owner satisfaction, and this contributes to poor quality performance in the projects.

The fourth rank factor influencing quality is "Updating the knowledge" related to leadership category is supported by the findings by Tan and Guang Lu [15] who mentioned that leaders should continuously acquire and update the knowledge that is valuable for implementing quality projects. Creating, updating and sharing knowledge is important to effective leadership, for which the firms must promote knowledge giving as well as knowledge seeking.

The fifth rank factor influencing quality is "Planning and managing human resources" related to people category. Mawhinney [16] pointed out that human resources management has a significant aspect of the whole planning and project management process in construction projects, in particular international construction projects that involve foreign firms as collaborators or competitors. Summers [17] stated people resources should be planned and managed for the improvement of quality objectives.

4 Conclusions and Recommendations

The above-mentioned findings of this study revealed that the top five factors influencing quality in the Indian construction industry based on the ranking of factors by RII are conformance to codes and standards, quality documentation, satisfying customer's needs, updating

the knowledge by the leader and better planning and managing human resources. The performance in the Indian construction industry can be increased by studying and improving the factors that affect the quality significantly. The surveyed clients, contractors and consultants ranked "Conformance to codes and standards" as the most important factor influencing quality in Indian construction projects. The top ranked factor "Conformance to codes and standards" in the process category is ranked first in its effect, among all the investigated factors which indicates the significant influence of this factor on quality in construction projects. As pointed out by Arditi and Gunaydin [18], quality designs must comply with relevant codes and standards and the design professionals must be familiar with it before the start of the design process. The second ranked factor "Quality documentation" in the partnership and resources category is ranked two in its effect, among all the investigated factors. From client, contractor and consultant perspective, effective quality documentation enhances the quality assurance system and serves as the basis for future references. This in line with the results of Tilley et al., [19] who stated that the major reason for rework in construction is poor quality documentation. The third ranked factor "Satisfying customers needs" in the process category is ranked three in its effect among all the investigated factors. This is supported by Yasamis et al., [20] who stated that strong quality culture in the firms helps in achieving customer satisfaction. The findings of this study are expected to make significant contributions to the Indian construction industry to result in continuous improvement of quality in construction projects.

REFERENCES

- [1] J.Motwani and A.Kumar, "A roadmap to implementing ISO, 9000", International Journal of Quality & Reliability Management, Vol. 13, pp. 72-83,1996.
- [2] K.N Jha and K.C Iyer,"Critical factors affecting quality performance in construction projects", Total Quality Management, Vol.17, pp. 1155 -1170,2006.
- [3] Matlhape and N. Lessing, "Employees in Total Quality Management", Acta Commercii, Vol 2, pp.21-34,2002.
- [4] J.Oakland, *Total quality management - Text with cases*, 2nd edition, Butterworth-Heinemann,2000.
- [5] G. S. Sureshchandar, R. Chandrasekharan and Anantharaman,"A conceptual model for total quality management in service organisations", Total Quality Management, Vol.12, pp. 343-363,2001.
- [6] Z . Isik , D. Arditi , I. Dikmen and M.T. Birgonul, "Impact of resources and strategies on construction

- company performance”, Journal of Construction Engineering and Management, Vol.26, p. 9-18,2009.
- [7] J.M. Juran and A.B. Godfrey, *Juran's Quality Handbook*. McGraw-Hill Book Company, Singapore,2000.
- [8] D.Leonard and R.McAdam, “The strategic placement of TQM in the organisation: A grounded study”, *Managing Service Quality*, Vol.12, pp. 43-53,2002.
- [9] T.Chinda and S.Mohamed, “Structural equation model of construction safety culture, Engineering”, *Construction and Architectural Management*, Vol. 15, pp. 114-131,2008.
- [10] A.M. Idrus and M. Sodangi, “Framework for evaluating quality performance of contractors in Nigeria”,*International Journal of Civil & Environmental Engineering*, Vol.10, pp. 31-36,2010.
- [11] K Patel and N Chotai, “Documentation and Records: Harmonized GMP requirements”,*Journal of Young Pharmists*, Vol. 3, pp.138-50,2011.
- [12] A.R Rezaei, T. Celik and Y. Baalousha , “Performance measurement in a quality management system”, *Scientia Iranica*, Vol.18, pp.742 -752,2011.
- [13] Z.M. Torbica and R.C Stroh, “Customer Satisfaction in Home Building”, *Journal of Construction Engineering and Management*, Vol. 127, pp. 82-86,2001.
- [14] A.H. Al-Momani , “Examining service quality within construction processes”, *Technovation*, Vol. 20, pp. 643-651,2000.
- [15] R.R. Tan and Y.Guang Lu, "On the quality of construction engineering design projects: criteria and impacting factors",*International Journal of Quality & Reliability Management*, Vol. 12, pp.18 - 37,1995.
- [16] M. Mawhinney, *International Construction*, Blackwell Science, Oxford,2001.
- [17] D.C. Summers, *Quality management: creating and sustaining organizational effectiveness*, Pearson Prentice Hall, New Jersey,2005.
- [18] D. Arditi and H.M. Gunaydin, “Total quality management in the construction process”, *International Journal of Project Management*, Vol.15, pp. 235-243,1999.
- [19] P.A. Tilley and R. Barton, “*Design and documentation deficiency - causes and effects*”, *Proceedings of the First International Conference on Construction Process Reengineering*, Gold Coast, Australia, pp. 703-712,1997.
- [20] F. Yasamis, D. Arditi, and J. Mohammadi, “Assessing contractor quality performance”, *Construction Management and Economics*, Vol.20, pp. 211-223, 2002.