

A STUDY ON THE APPLICABILITY OF QUALITY CIRCLES TO CONSTRUCTION PROJECTS

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Abstract

There is a rising need for infrastructural development in the city of Bangalore. As there are over 800 construction, civil engineering, building and development firms in and around the city, there is high competition. One of the factors which proves to be imperative in giving a competitive edge to these firms is good quality of their work among others like improved productivity and timely completion of their projects. Quality circles (QC) have been found to be a simple and productive technique of Total Quality Management (TQM), despite having low cost of quality. Although QC is native to the production industry, it has been proposed to be implementable in construction industry. QC's have never reportedly been used in the Indian construction industry. As the construction industry is significantly different from the production industry and the Indian organisational culture is also very different as compared to many countries like Japan where QC's thrive, this paper seeks to analyse and study the applicability of QCs as an efficient TQM method to construction projects in and around Bangalore city. This paper seeks to accomplish this by highlighting the favourable conditions and hindrances that application of QC's might face in Indian construction industry. The research methodology includes a detailed literature review and a questionnaire survey. The data was analysed using Index Average Method and percentage representations, both accompanied by descriptive analysis. Based on the analysis of the data obtained from the survey it was concluded that the Indian construction industry possesses various conditions which prove to be highly favourable towards the application of QC, however the temporary nature of the teams formed on construction projects, and the present organisational culture which might not support participative management have been found to be questionable conditions, which require improvement.

Key Words: Quality Circles (QC), Total Quality Management (TQM), Participative Management, and Facilitator

1. INTRODUCTION

Presently the construction industry is one of the fastest growing industries in India. The Indian construction industry is an integral part of the economy and is poised for growth.

The construction sector is the largest employment sector in the country after agriculture, employing about 31 million people and accounts for about 6-8% of the GDP. Construction industry throughout the country has been stimulated due to increased levels of investment by the government in infrastructure and real estate projects, as well as the government's decision to allow 100% Foreign Direct Investment (FDI) in real estate industry (E C Harris Research, International Focus on India, summer 2011) [9].

The city of Bangalore has been a thriving point for the growth of the construction industry in recent years. About 5-6% of the total Gross State Domestic Product (GSDP) of the state of Karnataka has been formed by the construction sector of Bangalore alone [4]. There are over 800 firms/companies which make up Bangalore's construction sector [7]. According to Abd Majid and McCaffer (1998) [1], the construction industry of various other countries (with economies similar to India) are faced with problems such as high fragmentation, instability, low productivity, poor quality and lack of standards. It is due to these

problems that clients remain unsatisfied with the performance achieved on many of their projects (Kometa & Olomolaiye 1997) [15]. Hence it becomes imperative to increase the quality of construction while still staying within the budget of a construction project, if the companies are to maintain a competitive edge in the market.

From Nashwan Mohammed, Noman Saeed and Awad Hasan (2012) [17], we know that effective TQM can directly reduce the overall duration as well as cost of a construction project. Especially with the sudden increase in the foreign investment in real estate, there is an added necessity for quality of international caliber. TQM proves to be of utmost importance as it is a process oriented quality management technique and gives rise to continual improvement of activities and processes within a construction project.

Quality Circles (QC) is a TQM method of utmost simplicity which can be easily adopted in this case. There have been no reported instances with regard to usage of QC in construction industry, while there has been an experimental study done on its usage in the American construction industry. Quality Circles are small volunteer groups of employees who work in the same environment, who meet regularly to talk about and analyse work related problems, defects and deficiencies, and suggest solutions to their

management, on implementation of which, these problems may be overcome. The concept of Quality Circles has been explained in detail in the literature review portion of this paper.

1.1 Problem Statement

One of the most prominent problems that countries like India face with regard to their construction projects is quality of construction which is below par as compared to international standards. There is a need for finding substantial solutions to these problems quickly. Quick problem solving leads to improved quality of construction, maintenance of schedule etc. The use of Quality Circles could prove to be an efficient problem solving technique which can improve the quality of construction. However,

- [1]. The temporary nature of teams formed by Quality Circles from project to project or even through the same project could affect the effectiveness of this method.
- [2]. The change in team dynamics and thus teamwork with the change/replacement of one or more of the members of a QC team has never been considered or studied.
- [3]. The applicability of QCs to India and considering the difference in India's organisational and cultural aspects as compared to the global scenario has never been considered. This is especially important to consider as QCs rely on bottom-up communication to take the necessary decisions.

1.2 Research Objective

This paper seeks to analyse and address all of the above mentioned issues. It seeks to be an exploratory study into understanding the feasibility of applying Quality Circles to Indian construction projects. Through the literature review, various conditions which support the application of quality circles have been brought to light, this research seeks to check for the availability of those conditions on construction projects and in construction organisations so as to assess the applicability of Quality Circles on construction projects. The key objectives of this research paper are,

- [1]. To study the applicability of quality circles to Indian construction projects as an efficient TQM method, by gathering the opinions of personnel from the construction industry, regarding the basic characteristics of quality circles.
- [2]. To study the willingness of construction organisations to use quality circles.
- [3]. To identify whether it is viable to include labours into quality circles, as a source of valuable information.
- [4]. To raise awareness about Quality Circles as potentially, an effective Total Quality Management program that can be easily introduced and accepted by organisations and potential participants.

1.3 Scope of Research

The very essence of the concept of Quality Circles and all aspects that contribute to it were studied by a detailed literature review of the theory of Quality Circles and

previous research done in this particular field. Using the knowledge and information obtained from the literature review, a wide range of conditions which could prove to be favourable or hindering towards the application of Quality Circles were listed. A questionnaire was constructed using the conditions listed from the literature review. This was followed by a data collection in terms of a questionnaire survey conducted among various competent personnel from the construction industry and collected data was analysed by statistical analysis and descriptive methods.

1.4 Research Methodology

The research was conducted in four main stages. The first stage involved identifying the research problem, setting the aim and objective for the research and developing a research plan. The second stage included reviewing the literature with regard to Quality Circles in general, an overall look at the Indian construction industry, Quality Circles in India (in other industries, as Quality Circles have never been used in Indian construction industry), and motivational factors involved with being a part of a Quality Circle. The third stage involved developing a questionnaire to investigate the availability of the necessary conditions to effectively implement quality circles in Indian construction industry. A pilot questionnaire was done and was followed by a main questionnaire survey of 32 respondents ranging from various construction organisations and various hierarchical levels. The questionnaire questioned respondents on their opinions regarding the various characteristics of quality circle and regarding the availability of certain conditions necessary for successful application of quality circles. It also contained questions regarding all the points mentioned in the problem statement and objectives. The fourth stage involved analysis of the data that was obtained through the questionnaire survey. The analysis was done by statistical methods (IBM-SPSS) and the results were descriptively put forward to obtain clear knowledge about the data collected and analysed. Discussion for the obtained results was done and finally conclusions of the research were drafted.

2. LITERATURE REVIEW

Fundamentally a Quality Circle is a small volunteer group of employees who work in the same environment, who meet regularly to talk about and analyse work related problems, defects and deficiencies, and suggest solutions to their management, on implementation of which, these problems may be overcome. This is a participative problem solving concept, the history of which dates back to the 1950s. It was developed in Japan by two American management and economy consultants, namely J. M. Juran and Edward Deming. This was in response to the poor quality of Japanese products, which were unable to compete in international markets with western counterparts after World War II. Kaoru Ishikawa, president of the Musashi Institute of Technology of Tokyo, helped organise quality circles in Japan in the early 1960s (Gilly 1986 [10], Ishikawa 1985 [13]). Joel E. Ross and William C. Ross (1982) [22] defined a quality circle as "a small group of employees doing similar or related work who meet regularly to identify, analyse, and

solve product-quality and production problems and to improve general operations. The circle is a relatively autonomous unit (ideally about 10 workers), usually led by a supervisor or a senior worker and organised as a work unit.” Since its introduction and development in the 1960s, quality circles have grown in popularity immensely, in Japan and various other places around the world. The people-orientation and team building approach of quality circles is where its vitality lies. Each individual’s ability and potential to contribute to a team effort, either by generating ideas or at least improving ideas already offered by team members is recognised. Every member of the quality circle is personally involved in setting goals for greater achievement and together seeks to formulate smarter and more efficient ways to work. They enhance the total quality of the work done and their work life by, building their personality and creating for their peers as well as themselves a better physical and working environment. Thus we can summarise the attributes of quality circles as,

- Participative Management technique
- Human Resources Development technique
- Problem solving technique

Quality Circles are native to the production and manufacturing industry and were later on implemented in various other industries of which construction industry is a part of. The success of the program requires mindful planning, serious commitment and encouragement from the management’s side. The program requires continuity and must not be abandoned after being used for a period of time. It is important that participation in the circle’s activities be voluntary as there is not extrinsic motivation and all members must be intrinsically motivated to contribute to the circle regularly. Quality circles give the employees a sense of participation and cooperation, furthering the undeniable effect on morale and motivation (Juran 1980 [14], Ishikawa 1985 [13]). The employees become more concerned about the organisation’s problems and are motivated to reach a position of higher decision making power. When they receive this type of power and see the management involve them in participative decision, the employees obtain a sense of ownership and loyalty towards their organisation.

2.1 Objectives of Quality Circles

Chaudhary and Yadav (2012) [16] have listed some objective of quality circles. They are;

- To bring a change to the attitude of the employees.
- To facilitate the continuous improvement of the employees as well as the organisation
- To bring out the hidden potential of the employees and hence bring self-development to the employees.
- To develop team spirit within the employees resulting in zero conflict among the management and employees.
- To improve organisational culture.

2.2 Structure of Quality Circles

The typical organisational structure of an organisation where quality circles are being used is shown below in Fig. 1. As stated by Ross et. al. (1982) [22] a circle is usually made up of 10 members who work together, which comprises of people who work in the office, middle level management personnel, supervisors and foremen (talking in terms of the construction industry). They meet for about an hour a week so as to identify, isolate, discuss and solve problems that they face such as quality and productivity issues. The typical quality circle has the following structure;

- [1]. Steering committee
- [2]. Circle coordinator
- [3]. Facilitator
- [4]. Leader
- [5]. Members



Fig -2.2.1 Structure of Quality Circles

The top management initially approves the implementation of quality circles and further goes on to approve or disapprove the implementation of suggestions made by them.

The Steering committee is comprised of managers in the field of quality, who act as an advisory and policy-making group. They exchange information and knowledge suitable to the methodology and use of quality circles, while supporting and monitoring and providing guidelines to them.

The Circle coordinator directs administration of the circles’ program and supervises the facilitators. Many companies don’t usually have a coordinator because, in the initial stages of implementation of quality circle programs an organisation might use a consultant coordinator and with the progress of time his role is most usually taken over by the facilitator.

The Facilitator acts as a liaison to management. He identifies expects and brings them to circle meetings and chooses the problems that the circles can work on overcoming. The facilitator trains the circles and the circle leader, the details of which we will look at further into the literature review.

The Leader watches over and manages the circle meetings, regulate the participation of the members and carefully regulate the execution of each step in the problem solving process.

Being the most important part of the circle, the members participate in the meetings, identify and analyse problems, collect data, determine and suggest solutions to the management. If the management approves, these solutions are implemented by the members. The management and non-circle members are kept well informed of the circles activities so that, they can also contribute their ideas to finding a solution to any problem.

2.3 Process of Quality Circles

As quality circles are a method of TQM, it is a process oriented method. Once the circles are formed, the facilitator imparts training onto the members. After their training is complete, a quality circle is ready to be implemented. Tushar and Desai's research [18] shows the above flowchart in Fig. 2 which depicts the entire process used to obtain improved quality and productivity.

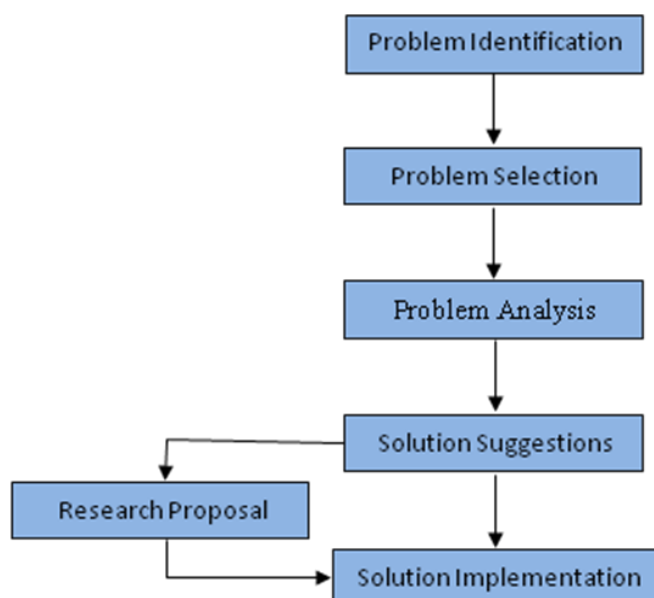


Fig- 2.3.1 Process of Quality Circles

The first step of the process is to identify the problem, the circle members meet on a regular basis and discuss about what the possible causes for a problem/problems. Next, they move on to ranking the problems or isolating the problem of greatest magnitude. They move on to further analyse the problem and discuss the possible solutions to them and rank or prioritise the most effective or efficient solutions. These suggestions are put forward to the management to be approved, on approval of which they would be implemented.

2.4 Characteristics of the Construction Industry

The construction industry differs from the production and manufacturing industry in various ways. Thus we need to take into account the differences in the characteristics of the two industries when we implement quality circles to suit the construction industry, while it was originally developed in the production and manufacturing industry. According to Bruno A. Gilly (1987) [5], the following are some of the factors which clearly distinguish the construction industry

from the manufacturing industry, while considering use of quality circles.

- **Project Uniqueness-** Every construction project is different from the other and hence unique. This is because different projects are built under different conditions, by different work force in different locations (Araki 1984 [3], Gilly 1986 [10]). Depending on the locations the projects are designed and planned differently. Even factors such as difference in season during a particular phase of a project contribute to it being planned in a different way as compared to another.
- **Duration-** The time which is taken to complete a project i.e. the end product is very long as compared to the manufacturing industry which take much lesser time to manufacture a product sometimes even to the extent of producing numerous products a day. Also the uniqueness of project causes the duration of the project completion also to be unique.
- **Sub-Contractors-** Most times in construction projects the main contractor completes various parts of construction by employing that particular part to subcontractors. In this case the main contractor does not have much control over the sub-contractors personnel. Whereas in manufacturing industry it is a set workforce working toward manufacturing the same product day-in and day-out, who are all employed by the main production company.
- **Influence of Owners-** It is not uncommon that the owner influences the project by making changes to the design and/or specification. This causes a change in the duration or the activities involved. Whereas in the other industries there is no such influence from the owner on the production.
- **Hierarchy of Organisation-** The hierarchical levels in a construction company are relatively low as compared to other industries i.e. there are very few levels between the highest ranking and lowest ranking individuals (Parker 1980 [19]). This could allow faster adjustment to changes and reaction but will require a high degree of communication skills from the management's side.
- Some of these factors could prove to be a barrier to the use of quality circles in construction projects especially such factors as project uniqueness, sub-contractors and also hierarchy of organisations. Especially considering India's difference in organisational culture as compared to the rest of the world the factor of hierarchy poses an important question mark into the applicability of quality circles in India. This is because Quality circles use a bottom-up approach i.e. participative management approach to solving problems arising in any project.

2.5 Quality Circles in India

BHEL (Bharat Heavy Electricals Ltd.) was the first organisation to introduce the concept of quality circles in 1981, in Ramachandrapuram, Hyderabad, under the initiation of Mr. S. R. Udpa-GM-Operations. The senior

management of BHEL which was headed by Mr. Madhav Rao, Chairman and Mr. K. L. Puri, Managing Director gave their full support and encouragement to this concept. Thus the quality circle movement began successfully in India and quickly picked up speed [21].

Over the years quality circles have been successfully implemented in various government organisations as well as private organisations. From the research of R. N. Rani (2009) [23] we see the effectiveness of quality circles programs in terms of cost-saving ratio to be varying from organisation to organisation, highest being BHEL (cost saving ratio between 10:1 and 5:1, which is very effective) and lowest being Amul (cost-saving being very low and thus not effective).

Gilly (1987) [5] says that western countries have had lesser success with quality circles concept as compared to Japan, due to the vast differences in work culture as well as social differences. The same is applicable to India, our organisational culture is very different as compared to both the Japanese as well as western countries. The major areas of difference are management philosophies, labour attitudes, society, pay system, government role, turn-over rate of labours, labour-management relationship etc. as told by Ishikawa (1985) [13]. Similar to the western countries, Indian companies also have a work culture where in management-labour relationship is based on momentary gains, less loyal and less friendly.

From a telephonic conversation with Mr. B. N. Nagraj, Quality Circles Forum of India, Bangalore Chapter [6], the researcher of this paper ascertained that there has been no reported use of quality circles in construction industry in India and thus even in the city of Bangalore. It has been over 30 years since the concept of quality circles has come to India and yet the construction industry is far behind other industries in terms of its use as an effective TQM method. In India organisational cultural differences which is a factor of consideration general to quality circles and various other factors of consideration like uniqueness of project and duration, variability of work force etc., which are specific to the construction industry, make for reasonable scepticism with respect to the applicability and effectiveness of quality circles in the Indian construction industry. Thus the intension of this research is to clarify this scepticism by studying the implement-ability of quality circles as an effective TQM method in the Indian construction industry.

2.6 Motivational Aspect Of Quality Circles

Rani (2009) [23] says that, it is well known that all people are different from each other not just in their ability or proficiency in doing a particular work but also in their willingness to do that particular work. The strength of people's motives determine the motivation with which they work. Motives can be very different such as needs, wants, impulses within an individual etc. Being social animals human beings like to work with each other in the society. Pressure and competition also make individuals work harder. There is variability in motivational needs from individual to individual, thus it is important that an employer understands the motivational needs of his employee so as to effectively motive the employee and

create a healthy workplace environment for him/her. There are various motivational theories discussed by Hersey and Blanchard (1977) [12] which talk about the different needs or classification of needs of an individual. Broadly the motivation can be classified into two types; intrinsic motivation and extrinsic motivation. Intrinsic motivation being the motivation that a person gets from the satisfaction of the job and appreciation etc. i.e. the motivation that comes from within, while extrinsic motivation is that motivation which comes from external factors such as material or financial rewards.

The voluntary nature of a quality circle and also the fact that they do not receive extra pay or incentive for partaking in these programs suggests that there is a motivational aspect to quality circles. Thus it is clear that the members of the quality circle must be intrinsically motivated to be effective contributing members to the program. The management needs to regularly motivate the circle members to keep them enthusiastic about the work they do in the program. Also the idea that the circle members have a say in important decisions made by the management i.e. participative decision making, motivates the circle members to do a good job by giving them a sense of belonging and ownership towards their organisation. The way the concept of quality circles are put forward to the circle members, be it middle management, foremen or labours, plays an important role in their involvement and enthusiasm about the program. If the concept is not put forward in a proper way, employees would rarely choose to be a part of the quality circles or even if they do choose to be a part of the circles, they remain indifferent or even hostile, often discounting the effectiveness of the program hence becoming counterproductive. While when concept is put forward in a proper way and the circle members are motivated regularly, the program is shown to reduce absenteeism and grievances, giving all members job satisfaction and improving teamwork.

2.7 Possible Hindrances to Quality Circles in Indian Construction Industry

It is clear from all the above literatures that there are possible hindrances to the use of quality circles as an effective TQM method. They can be listed down as follows,

- The uniqueness in different construction projects set them apart as compared to the manufacturing industry where in a particular product is manufactured every day.
- The problems faced could have a short term relevancy, especially when facing problems which pertain to weather or seasons. There is a dynamic nature of the construction site environment with the progress of the project.
- The temporary nature to the workforce on a construction project. It is rare that on completion of a construction project, the same team of all hierarchical levels which has worked on that project will come together to work on another construction project. Thus the maximum lifespan of a quality circle would be only as long as the duration of one construction project.

This is also due to the employment of sub-contractors to do certain works of the project.

- There is high rate of turn-over in the construction industry, thus if a member were to exit the circle, it would affect the team dynamics that the circle previously possessed. Also the addition of a new member to fill the position of the exited person would cause friction with in the team.
- While conventionally all hierarchical levels quality circle program is open to all hierarchical levels of an organisation, in construction industry the labours can't be considered due to the fact that they work on daily wages basis and they do not usually work long term on a particular project. Also with change in the various activities of the construction project there will be change in the foreman in-charge, this could also prove to be a problem with regard to team dynamics since foremen would keep entering and exiting the quality circles though the course of the project.
- The cost-saving ratio might turn out to be low as we see in the case of AMUL. If proper approach is not taken while bringing members into the quality circles, the program could turn counterproductive.
- The organisational culture that we have in India might not prove suitable for participative problem solving techniques. If a solution to a problem is suggested by a circle member holding lower designation, however viable the solution might be, the ego of a member of the circle holding higher designation might play a negative role in accepting or supporting this solution.
- Since quality circles work on intrinsic motivation and not extrinsic rewards, it not be applicable in the lowest or lower hierarchical levels of an organisation where the motivational needs of an employee might be more materialistic than intrinsic factors like job satisfaction or appreciation.

2.8 Favourable Characteristics of Indian Construction Industry to Quality Circles

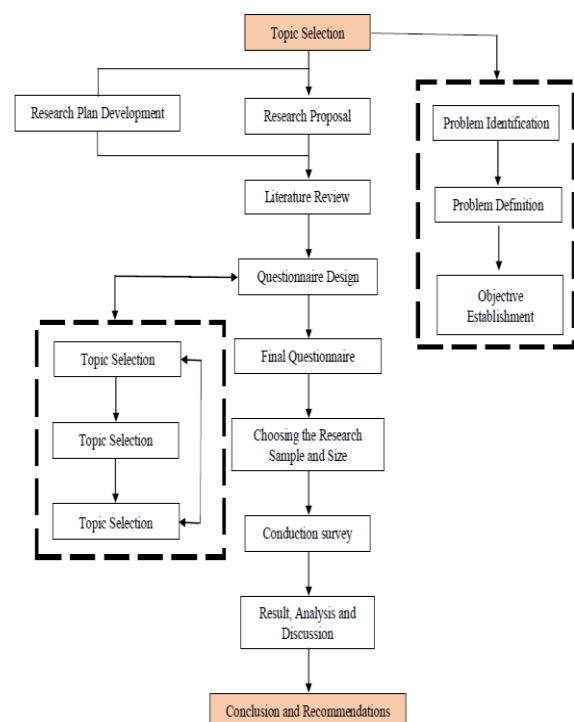
We can also deduce from the above literature, certain characteristics of the construction industry which could prove favourable to the implementation of the quality circles program. They are listed below,

- The presence of very few hierarchical levels in the construction industry makes for an easier pathway of communication.
- The ability of the foremen or site superintendents to make corrections or modifications to the works in construction industry score over the manufacturing where a particular product had to be manufactured exactly according to its manufacturing process. This factor almost guarantees fruitful solutions from the circle.
- Even though every construction project is different, most activities involved in it are the same. Thus if a solution to a problem is given during one project, the same solution can at least be used partially on encountering similar problem in a project that might follow.

- If a quality circle that worked on one project is maintained without being split up, even in another project, then the uniqueness of the projects will pose a challenge to them, thus making work more interesting and less monotonous.
- A quality circle is known to identify a problem and come up with a simple solution quickly as compare to the project planners. When sticking to a schedule, a fast simple solution is preferred over a perfect solution which takes a long time to formulate. Thus quality circles can provide solutions to problems which could delay a project, hence ensuring timely completion of a project.
- In most other industries quality circles must make recommendations to the management who will approve or disapprove the solution. But in the case of construction industry, most of the decisions towards implementation of solutions to simple problems are done by the middle level management or even the foreman, thus there is no delay in receiving approval, or no scenario of solution disapproval since the decision maker is most likely to be a part of the quality circle.

3. RESEARCH METHODOLOGY

The investigation of the problem statement has been explained under this heading. Further, the tools used to investigate the mentioned problem statement are explained. The Opinion-based research explained by David N. Sillars and Matthew R. Hallowell (2009) [8] has been adopted here. The method of data collection, characteristics of the research sample and methods of analysis used in this research has been explained below. Fig 3.1 shows a flowchart containing the methodology used in this research and how it leads to achieve the objectives of this research.



3.1 Literature Review

From the above literature review various favourable characteristics of construction industry to the application of Quality Circles and the possible hindrances that the Indian construction industry faces to the application of Quality Circles were compiled.

3.2 Questionnaire Survey

A questionnaire survey was designed to further this research work, taking into consideration the aim and objectives of the study. The questionnaire was set up in such a way as to question the availability of Quality Circles' favourable conditions and hindrances on any construction projects, from personnel of the construction industry.

3.3 Questionnaire Design

The research methodology adopted for this research is a questionnaire survey. The target population was personnel from various hierarchical levels of the construction industry who could provide valuable opinions in regard with the characteristics of a construction project (those characteristics which could favour or hinder the applicability of Quality Circles). Various hierarchical levels of an organization were considered so as to get a combined opinion of all possible participants of a general Quality Circle. Due to financial and time constraints, a target population of 32 respondents was set, consisting of the hierarchical levels, Top Management- 7 respondents, Middle Management- 6 respondents, Lower Management- 6 respondents, Engineering Personnel- 7 respondents and Technical Support Staff- 6 respondents. All the respondents have been distributed evenly through all hierarchical levels so that the results obtained are more realistic, not being biased towards any particular hierarchical level. While designing the questionnaire, considerations were made so that all the questions would directly reflect on the aim and objectives of the study with a clear intention to provide sufficient background of the respondents and to effectively obtain their honest professional opinions. The literature review done in this research was used as a theoretical basis for the content and format of designing this questionnaire survey.

3.4 Instrument Validity

According to Grove and Burns (1993) [11], the determination of the extent to which the instrument actually reflects the abstract construct being examined is known as the instrument validity. The validity of the questionnaire's content was evaluated by two groups of experts. The first was requested to evaluate and identify whether the questions agreed with the scope of the items and the extent to which these items reflect the concept of the research problem. The other group (experts in statistics) was asked to identify that the instrument used was valid statistically and that the questionnaire was designed well enough to provide relations and tests among variables.

All additions, omissions and the new questions were discussed and approved by the thesis supervisor (second

author) and then the questionnaire was finalized to include 46 questions to assess the respondent's honest opinion, organisational practices and culture.

3.5 Pilot Survey

A pilot questionnaire survey was carried out to identify the validity of the questions, the appropriate wording to be used in the questions as some of the respondents could possibly experience some difficulty in understanding some of the terminologies involved in the topic. Thus the phrasing of the questions in a way that can be easily understood by the respondents was given special attention. The primary objective of carrying out the pilot survey was to test the reliability of the questionnaire. The survey was carried out with selected professionals who have extensive experience in the construction industry and care was taken to make sure all hierarchical levels were well represented in the pilot survey as well.

The responses of the questionnaire gave the opportunity to improve on some of the questions and to further simplify the phrasing used in the questionnaire. As a result various changes were made so as to make the questionnaire easier to answer and yet provide the gathering of substantial, honest responses.

3.6 Instrument Reliability

Reliability is known as the quality of being dependable. The reliability of the questionnaire (to find out if the questionnaire is designed and structured in such a way that the responses obtained from it can be depended on or not) was sought to be found. The reliability of an instrument is the degree of consistency which measures the attribute it is supposed to be measuring (Pilot and Hunger 1985) [20].

To facilitate this, Cronbach's Alpha (also known as coefficient of internal consistence) test of reliability on the SPSS package, which is a statistical software developed by IBM was used. Thus this test serves to show whether the questionnaire has an acceptable degree of internal consistency or not. Cronbach's Alpha can be written as a function of the number of test items and the average inter-correlation among the items. The formula for standardised Cronbach's Alpha is shown below for conceptual purposes.

$$\alpha = \frac{kr}{1 + (k-1)r}$$

Where, k is the number of items and r is the average inter-item correlation among the items.

According to Akintoye and Fitzgerald (2000) [2], an acceptable or modest reliability is said to be in the range of 0.5-0.6. On entering the data from all the questionnaires into SPSS and testing for Cronbach's Alpha reliability, the "Cronbach's Alpha" value was found to be 0.753 and "Cronbach's Alpha based on standardised items" value was found to be 0.826. Thus it can be clearly seen that the questionnaire has very well met the reliability requirement.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.753	.826	32

Table 3.6- Cronbach's Alpha for the questionnaire using IBM SPSS software

3.7 Methods of Analysing the Questionnaire Survey

Considering the method of analysis at an earlier stage than the data collection is of utmost importance. The reason for this is that the method of analysis determines the type of data to be collected and the structure of the questionnaire.

All data obtained were analysed by descriptive and analytical methods. A simple percentage distribution using pie-charts followed by a descriptive analysis has been used for the responses of Part A and Part B as these parts show general information like experience of respondents, number of projects completed by the organisation represented by the respondent, quality practices of the organisation represented, etc. Data of Part C was analysed by using Index Average Method [3] as follows.

$$\text{Index Average} = \frac{(\sum a_i * x_i)}{\sum x_i}$$

Where:

a_i = constant

x_i = variables representing respondents' frequency

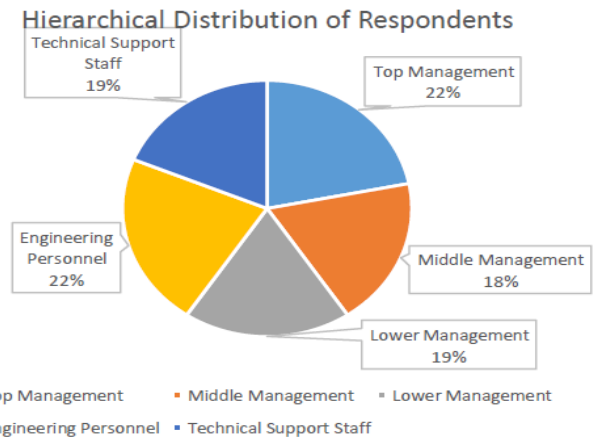
4. RESULTS

4.1 Response Rate

The organisational structure of any construction organisation was broken down into 5 distinct hierarchical levels and the respondents were carefully selected in a way as to represent each hierarchical level properly. The 5 hierarchical levels that a general organisation can be broken down into are listed below:

- Top Management
- Middle Management
- Lower Management
- Engineering personnel
- Technical support staff

As it was somewhat tough for Technical support staff to understand some of the questions which form the questionnaire, necessary translation and guidance was given to the mentioned respondents so as to ascertain their understanding of all the questions of the questionnaire. Out of the total 40 questionnaires which were distributed, a total of 32 were completed and returned by the respondents. Thus the response rate of the distributed questionnaire is 80%. The hierarchical distributions are shown below in Fig 4.1

**Fig 4.1-** Hierarchical distribution of respondents

4.2 Descriptive Analysis

The following are questions from the questionnaire survey which needed to be descriptively interpreted based on the collation of the responses.

Question 3: Experience held by you (respondent) in the field of construction.

Response Results- The experience of all the respondents from the questionnaire survey were consolidated and the above pie-chart was compiled.

-The "below 2 years" category comprised of 18.75% of all the respondents.

-The "2-5 years" category comprised of 9.38% of all the respondents.

-The "5-10 years" category comprised of 28.12% of all the respondents.

-The "above 10 years" category comprised of 43.75% of all the respondents.

The majority of the respondents were found to be under the category of "above 10 years" and the minority of the respondents was found to be under the category of "2-5 years".

Question 4: Are you (respondent) aware of Quality Management?

Response Results- The respondents' awareness about Quality Management was questioned, the responses were consolidated and the above pie-chart was compiled.

-93.75% of all respondents said "yes" and were thus well aware of quality management.

-6.25% of all respondents said "no" and were thus unaware of quality management.

Question 5: Are you (respondent) aware of Total Quality Management?

Response Results- The respondents' awareness about Total Quality Management was questioned, the responses were consolidated and the above pie-chart was compiled.

-31.25% of all respondents said "yes" and were thus well aware of total quality management.

-68.75% of all respondents said "no" and were thus unaware of total quality management.

Question 6: Are you (respondent) aware of Quality Circles?

Response Results- The respondents' awareness about Quality Circles was questioned, the responses were consolidated and the above pie-chart was compiled.

-56.25% of all respondents said "yes" and were thus well aware of Quality Circles.

-43.75% of all respondents said "no" and were thus unaware of Quality Circles.

The lack of awareness about Quality Circles was well established by the responses which show that almost half of the respondents have said "no". The respondents who have said "yes" to the awareness of Quality Circles can be attributed to the brief write up about QCs affixed to the questionnaires that were distributed. Thus one of the objectives of this thesis has been partially established

Question 7: Are you aware of Participative management?

Response Results- The respondents' awareness about Participative management was questioned, the responses were consolidated and the above pie-chart was compiled.

-68.75% of all respondents said "yes" and were thus well aware of Participative management.

-31.25% of all respondents said "no" and were thus unaware of Participative management.

Question 8: Would you like to be a contributor towards making decisions regarding solutions to problems faced on your construction project?

Response Results- The respondents were asked about whether they would like to contribute towards making decisions regarding solutions to problems faced on their construction project, their responses were consolidated and the above pie chart was compiled.

-93.75% of all respondents said "yes" towards being a contributor towards making decisions.

-6.25% of all respondents said "no" towards being a contributor towards making decisions.

Thus it is clear that nearly all the respondents would like to contribute towards making decisions regarding solutions to problems faced on their construction projects. A negligible minority said that they would not like to contribute towards making decisions regarding solutions to problems faced on their construction projects. This could be attributed towards taking unwillingness towards responsibility for a wrong decision made by them.

Question 12: Number of construction projects completed by the organisations.

The respondents were questioned about the number of construction projects each of their organisation has completed. All 32 respondents, answered with the response "above 20" which implies that all the organisations are experienced and have a well-established organisational culture.

Question 13: Is your organisation ISO certified?

The respondents were questioned on whether their organisation is ISO certified and if certified, what

certification they had. The responses were consolidated and the above pie chart was compiled.

-53.12% of all respondents said "no" i.e. their organisation is not ISO certified.

-28.13% of all respondents said "ISO 9001 certified".

-12.5% of all respondents said "ISO 9002 certified".

-0% of all respondents said "ISO 9003 certified".

-6.25% of all respondents did not respond to the question posed.

From the above percentage distribution we see that over half of all the organisations that the respondents belong to are NOT ISO certified. When questioned about it they said they follow their own quality standards but do not look for certification. About a quarter of the respondents' organisations are ISO 9001 certified and a small portion said that their organisation is ISO 9002 certified. About 6.25% of the respondents did not answer the question which suggests that they are not willing to reveal the quality trends followed by their organization

Question 14: Does your organisation apply quality management?

The respondents were questioned on whether their organisation applies Quality management. The responses were consolidated and the above pie chart was compiled.

-87.5% of all respondents said "yes", their organisation does use Quality management.

-12.5% of all respondents said "no" their organisation does not use Quality management.

From the above percentage distribution we can see that the majority of the organizations represented by respondents, use Quality management. Yet there is a small minority of organisations which the respondents represented, which do not use Quality management. This means through this questionnaire survey, we can raise and have raised awareness about quality management and its importance in terms on application to improve the quality of any construction project.

Question 15: What quality management program/process does you organisation use?

This was a subjective question through which the present quality management programs/processes used by the organisations that the respondents represented, were compiled. This would help us to understand the present trends in quality management and evaluate if they provide a positive environment for the application of quality circles. The answers given by the respondents follow.

-Check Lists.

-As per IS.

-Benchmarking, Reciprocating process etc.

-Company quality process manual.

-Group discussions.

-Customer feedback.

-Random Inspection and quality checks.

-Training sessions on Quality Management Systems (QMS).

-Planning meetings.

As we can see many of the above listed programs/processes like, group discussions, feedback, planning meetings etc. are in accordance with some of the tools used for effective

application and functioning of Quality Circles. Thus we can conclude that some of the present quality practices prove a positive environment for the application of Quality Circles.

Question 16: Does your organisation apply Total Quality Management?

The respondents were questioned on whether their organisation applies Total Quality management. The responses were consolidated and the above pie chart was compiled.

-56.25% of all respondents said “yes” their organisation does apply Total Quality management.

-43.75% of all respondents said “no” their organisation does not apply Total Quality management.

Thus we see that since majority of the organisations which were represented by the respondents, already apply Total Quality Management, they could easily introduce the application Quality Circles as one of its programs since the organisation is already familiar with process oriented quality management programs. While almost half of the organisations represented by the respondents do not apply Total Quality Management which shows us there is vast room for application of process oriented quality management programs and thus improvement in quality.

Question 17: Does your organisation use a consultant for ISO/TQM?

The respondents were questioned on whether their organisation uses a consultant for ISO/TQM. The responses were consolidated and the above pie chart was compiled.

-40.61% of all respondents said “yes” their organisation does use a consultant for ISO/TQM

-28.12% of all respondents said “no” their organisation does not use a consultant for ISO/TQM.

-31.27% of all respondents did not answer the above posed question.

The respondents who said “no” consist of those who mean to say, their organisation does not use a consultant and thus their organisation applies ISO/TQM themselves OR that their organisation does not use ISO/TQM at all. Those of the respondents who did not answer the posed question, thus mean to reinforce their organisations non-application of ISO/TQM. The pie chart for this has been shown in Fig 4.12 in the annexure section at the end of this thesis.

4.3 Conditions Favouring Application of Quality Circles (Using Index Average Method)

The questions comprising this portion of the questionnaire were either of 5 point ranking or of 2 point ranking. Thus to facilitate analysis of this data efficiently all questions which carry 5 point ranking have been grouped together and questions carrying 2 point ranking have been grouped together. Moreover, to facilitate easy understanding by all the respondents, the options to many of the questions were not generalised but rather worded such a way as to be in accordance with the questions. In the table below there is a generalisation which was used to analyse the data, side by side with the wordings used in the questionnaire along with the corresponding weightage for the said option.

Weightage	2	1
Generalisation	Favourable	Unfavourable
Wording used in questionnaire	Yes	No

Table 4.3.a- Assignment of weightages and terminology for 2 point rating

Weightage	5	4	3	2	1
Generalisation	Strongly favourable	Favourable	Neutral	Unfavourable	Strongly Unfavourable
Wording used in questionnaire	Very important	Important	Somewhat important	Not that important	Not important at all
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
	Excellent	Good	Fair	Below average	Bad
	Strongly motivated	Well motivated	Moderately motivated	Not very motivated	Not motivated at all
	Very enthusiastic	Enthusiastic	Neutral	Not that enthusiastic	Not enthusiastic at all

Table 4.3.b- Assignment of weightages and terminology for 5 point rating

4.3.1 Conditions Favouring Application of Quality

The responses to the questions which are framed in such a way that they fall into the category of being favourable towards the application of Quality Circles on construction projects, while also falling into the category of a 5 point ranking scale have been summarised below and analysed using the index average method.

From Table 4.3.1, it is seen that all 100% of the respondents agreed that the quality of construction is of great importance. We also see that 75% of all respondents said that their firms support participative management, this serves for a perfect environment for the application and efficient functioning of Quality Circles.

A vast majority of respondents i.e. 90.6% of all respondents said that degree of communication between employees of various hierarchical levels is at least good if not excellent. Communication is one of the necessity factors which are necessary for functioning of Quality Circles.

About 93% of all respondents said that they were intrinsically well motivated. This is of utmost importance for the application of QCs as it is a voluntary program and there is no financial reward in being a part of a Quality Circle.

Nearly all the respondents (97%) said that a problem faced on a construction project can be solved by discussion between the employees involved in the project comprising of the various hierarchical levels of the organisation.

About 81% of all respondents said that their suggestions made by them to problems faced on construction site would be considered regardless of their designation held. The organisational culture in India is very different from that which is present in Japan where Quality Circles originated and thrive even today. Thus we can say that even with India's difference in organisational culture, there could be sufficient acceptance to the working of Quality Circles.

Stunningly, 62% of all respondents said that the quality of their current construction project requires improvement. This is favourable as it shows room for improvement in quality, which a low cost high efficiency quality management program like Quality Circles can facilitate. About 84% of all respondents said that quick problem solving on construction site leads to maintaining project schedule, which will in turn contribute to reduction in duration and expense of a construction project.

Over 93% of all respondents said that the teamwork between the employees on their construction project was good if not excellent, this is definitely a favourable condition to the application of Quality Circles.

Nearly all the respondents i.e. 97% said that they are enthusiastic about accepting new quality management programs and practices that are introduced and initiated by their management, this also gives us a favourable environment for the acceptance of Quality Circle initiatives by the organisation's management.

All the respondents i.e. 100% of all respondents said that they would feel valued if their solution to a problem is considered, they would feel a sense of ownership towards their construction project if their solution to a problem would be implemented and that they would obtain job satisfaction if they were appreciated for their solution suggestions towards problems faced on their construction projects.

However only about 71% of all the respondents said that if they felt valued, appreciated and a sense of ownership towards their construction project, they would work more efficiently. This suggests that (valued, appreciated and feeling ownership) being intrinsically motivated does not completely contribute toward higher working efficiency of employees.

All the respondents (100%) said that a solution to a problem which is found at a particular construction project can be reused to solve a similar problem faced on a different construction project, this is a really important aspect as even if a particular Quality Circle team cannot continue to function post completion of their project, the solutions to problems found by them can be efficiently reused on various other construction projects in the future.

Problem faced on site can be solved by discussion	6	25	1	0	0	4.156	Favourable	
Question 28: Suggestions made by employees are considered regardless of their designation	1 1 2 2 3 6 3 3 3 2 0 2 1 2 1 1 0 0 0 0 0 0 0 0 0 0	9	17	6	1	0	4.156	Favourable
Question 31: Quality of works on current project requires improvement	1 0 2 1 1 1 5 2 4 3 1 1 2 0 1 2 0 0 2 1 2 0 0 0 0 0	5	15	5	5	2	3.5	Neutral
Question 32: Quick problem solving contributes to maintaining project schedule	1 1 1 1 1 3 4 4 6 5 2 1 1 0 0 1 0 0 0 0 0 0 0 0 0 0	5	22	4	1	0	3.968	Favourable
Question 33: Good degree of teamwork between employees at construction site	0 2 2 1 2 6 4 3 6 4 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0	7	23	2	0	0	4.156	Favourable
Question 35: Enthusiasm towards accepting new Quality Management initiatives	1 1 2 3 4 6 5 4 3 2 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0	11	20	1	0	0	4.312	Favourable
Question 36: Feeling valued your solution to problems are considered	2 0 1 3 3 5 6 5 4 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	9	23	0	0	0	4.281	Favourable
Question 37: Implementing your solution gives you a sense of ownership	2 2 1 2 2 5 4 5 5 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	9	23	0	0	0	4.281	Favourable
Question 38: Being appreciated for suggested solutions gives job satisfaction	3 1 3 4 2 4 5 3 3 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	13	19	0	0	0	4.406	Favourable

Table 4.3.1- Index average values for conditions favouring application of QC

About 93% of all respondents said that finding a solution to problem faced on a construction project, helps in avoiding that particular problem in the future. The last two point are in accordance with each other suggesting that the solutions found by Quality Circles have long term applicability and effectiveness, even post completion of the construction project in which it was formulated

4.3.2 Labourer's Inclusion into Quality Circles

It was one of the objectives of this research was to identify if it is viable to include labourers into the Quality Circles of a construction project. The responses to Question 42, which addressed this particular opinion of the respondents was consolidated, the table and pie chart below were compiled.

Question 42	5 Strongly Agree	4 Agree	3 Neutral	2 Disagree	1 Strongly Disagree	Index Average	Respondents' Opinion
Labourers could provide valuable information, with regard to solving problems faced on your construction project.	5	12	3	11	1	3.281	Neutral

Table 4.3.2 Index Average Value for Labourer's inclusion into QC

Scale	5 Strongly Favourable	4 Favourable	3 Neutral	2 Unfavourable	1 Strongly Unfavourable	Index Average	Category
Respondent's Category							
Criteria	Top Management Middle Management Lower Management Engineering personnel Technical support staff	Top Management Middle Management Lower Management Engineering personnel Technical support staff	Top Management Middle Management Lower Management Engineering personnel Technical support staff	Top Management Middle Management Lower Management Engineering personnel Technical support staff	Top Management Middle Management Lower Management Engineering personnel Technical support staff		
Question 18: Quality of construction is Important	6 5 6 6 5	1 1 0 1 1	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	4.875	Strongly Favourable
Question 19: Support Participative Management	1 2 0 1 1	4 3 5 4 3	2 1 1 2 2	0 0 0 0 0	0 0 0 0 0	3.906	Favourable
Question 22: Good degree of communication between various hierarchical levels	2 2 3 1 1	4 3 3 5 5	1 1 0 1 0	0 0 0 0 0	0 0 0 0 0	4.187	Favourable
Question 24: Good degree of intrinsic motivation	4 2 0 2 4	3 4 5 4 2	0 0 1 0 0	0 0 0 1 0	0 0 0 0 0	4.281	Favourable
Question 26:	0 2 2 0 2	7 4 3 7 4	0 0 1 0 0	0 0 0 0 0	0 0 0 0 0		

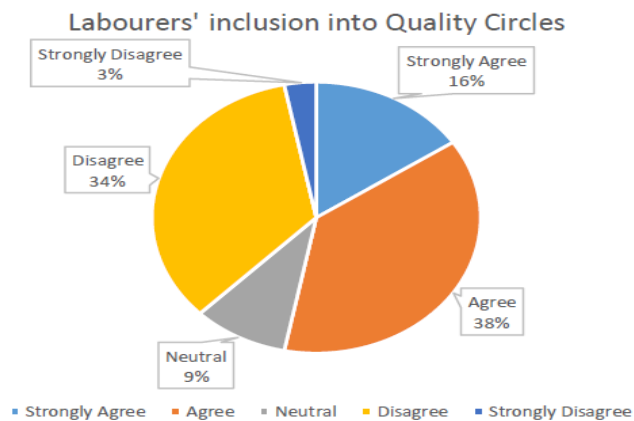


Fig 4.3.2- Labourer's inclusion into QC

The Index Average value for the above question is found to be 3.281 which translate to the respondents being neutral towards whether labourers' input of information could provide for substantial solutions to problems faced on construction projects. Moreover we see that almost half the respondents i.e. 46.87% were either neutral or disagreed, saying they were not sure or did not think labourers could provide viable information for solutions to problems faced on construction projects.

4.3.3 Questions Favouring Application of QC, carrying 2 point rating

The responses to all questions which are framed in such a way that they fall into the category of being favourable towards the application of Quality Circles on construction projects, while also falling into the category of a 2 point ranking scale have been summarised below and analysed using the index average method.

Scale	2 Yes					1 No					Index Average	Category
Respondent's Category	Top Management	Middle Management	Lower Management	Engineering personnel	Technical support staff	Top Management	Middle Management	Lower Management	Engineering personnel	Technical support staff		
Question 20: Does your organisation deploy the same foreman through various activities of the same construction project?	5	4	2	3	5	2	2	4	4	1	1.594	Yes
Question 23: Are you intrinsically motivated towards working on your construction project?	7	6	6	7	5	0	0	0	0	1	1.968	Yes
Question 25: Are foreman or supervisors allowed to make minor corrections to the works on construction site?	4	4	5	6	5	3	2	1	1	1	1.75	Yes
Question 27: Are you willing to be a part of a Quality Circle despite receiving no financial reward?	7	5	5	6	6	0	1	1	1	0	1.906	Yes
Question 40: If you are valued, appreciated and have a sense of ownership towards your construction project, would you be a part of a Quality Circle, despite receiving no financial reward?	7	6	6	6	6	0	0	0	1	0	1.968	Yes
Question 46: Would you recommend the initiation of a Quality Circle in a current or future construction project, to your organisation's management?	7	6	6	6	6	0	0	0	1	0	1.968	Yes

Table 4.3.3- Index average values for conditions favouring application of QC

From the above Table 4.3.3 we see that over half the respondents (59.37%) said that their organisation deploys the same foreman through various activities of the same construction project. This is a very favourable condition to the application of quality circles as the foreman can be effectively included into a Quality Circle, without having the discontinuity of entering and/or leaving the Quality Circle team with the progression of activities through the schedule of the project. Also the foreman will be able to contribute towards problems faced on a current activity using information from a previous activity if it is to be found relevant.

Nearly all the respondents (96.87%) said that they were intrinsically motivated towards working on their construction project. Intrinsic motivation is imperative for a member of a Quality Circle as it requires the member to offer extra service outside of his/her job description, without receiving any financial reward. Thus this proves to be one of the most favourable conditions affirming applicability of Quality Circles.

Majority of the respondents (75%) said that foreman are allowed to make minor corrections on their construction projects. When Quality Circles formulate a solution to a problem, they suggest it to the management of the organisation, who might choose to implement or discard the solution. This could prove to be a time consuming process in some cases. But as the foremen and supervisors from most of the respondent organisations are allowed with the freedom to make minor changes by themselves, it saves a lot of time which would be otherwise wasted in receiving approval for implementing some of these solutions.

Most respondents (90.6%) said they would be willing to be a part of a Quality Circle despite them not standing to gain any financial reward. This opinion was obtained after their proper understanding of how Quality Circles would function and how much more of their time and effort would be required for them to be a part of a Quality Circle. However there was a small minority (9.4%) who were not interested in being a part of a Quality Circle.

When asked whether they would like to be a part of a quality circle if they were to receive a financial reward (Question 41), nearly all the respondents (96.87%) said that they would. We can see a clear trend where in the willingness to be a part of a Quality Circle has marginally increase with the offer of a financial reward for their participation. Nearly all the respondents (96.87%) said they would recommend to their organisation's management, the initiation of a Quality Circle in a current or future construction project. It is also observed that all the respondents (100%) who fell into the category of Top and Middle Management, being the decision makers of any organisation, said that they would recommend the initiation of Quality Circles in a current or future project. Thus they represent their whole organisation in terms of making the decision to initiate Quality Circles in their organisation. Moreover this achieves one of the key objectives of this research which is to study the willingness of construction personnel to be a part of quality circles and construction organisation to use quality circles.

4.3.4 Total Conditions Favouring Application of Quality Circles

The number of questions (2 point rating as well as 5 point rating) which are framed in a way that they fall into the category of being favourable towards the application of Quality Circles to construction projects are 21. Since all these 21 questions have shown responses which have an Index Average value of greater than or equal to 1.5 for 2 point rating scale and greater than or equal to 3.5 for 5 point rating scale, we can say that all the responses are "Favourable" towards the questions and thus favourable towards the applicability of Quality Circles to construction projects. Thus since 91.3% of the conditions posed are favourable we can infer that the Quality Circles have high applicability to construction projects.

4.4 Questions Hindering the application of Quality Circles

The responses to all questions which have been framed in such a way that they fall into the category of being a hindrance towards the application of Quality Circles on construction projects have been summarised below and analysed using the index average method. There are only 2 questions which were framed negatively and intended to reflect a direct hindrance, they are tabulated in the Table 4.6 below. Since hindrance is the opposite of favourability, the weightage for this particular index average calculation has been given in opposition to the index average that was calculated for favourability thus it ranges from Strongly Unfavourable carrying maximum weightage of 5 to Strongly Favourable carrying a minimum weightage of 1.

Scale	5 Strongly Agree				4 Agree				3 Neutral				2 Disagree				1 Strongly Disagree				Index Average	Category										
Respondent's Category																																
Criteria	Top Management				Middle Management				Lower Management				Technical support staff				Top Management				Middle Management				Lower Management				Technical support staff			
Question 34: If any employee on your construction project exits your organisation or is replaced with someone else, the teamwork between employees is affected.	0	0	0	1	1	3	2	0	3	3	1	5	2	1	1	2	1	1	1	0	1	0	0	0								
	2				11				12				6				1				3.218				Neutral							
Question 45: An employee of higher designation than you might not be accepting of or support a solution to a problem suggested by you, only because you are of lower designation than him/her	3	0	0	0	0	3	2	3	4	2	0	1	2	0	1	1	3	1	2	2	0	0	0	1		1						
	3				14				4				9				2				3.218				Neutral							

- [4]. All the decision makers i.e. 100% such as Top and Middle level management said that they would recommend the initiation of Quality Circles on a current or future project. The Index Average value for this question was 1.968 (Strongly Agree)
- [5]. Nearly all the respondents showed a high degree of intrinsic motivation (96.87% said Yes, Index Average value- 1.968) and all its constituents in terms of feeling valued (100%, Index Average value- 4.281 i.e. Agree), being appreciated (71%, Index Average value- 4.406 i.e. Agree) and feeling ownership towards their construction project (100%, Index Average value- 4.281 i.e. Agree). This is of utmost importance as being a part of a Quality Circle is voluntary and does not return any monetary reward.
- [6]. 75% of the respondents said the foremen/supervisors on their construction projects were allowed to make minor changes on their construction projects, which provides a highly favorable towards applicability of Quality Circles. The Index Average value for this question was 1.75 (Yes i.e. it is a favorable condition)
- [7]. Labourers were opinioned to be an ineffective source of information towards problems faced on constructions by 46.87% of respondents which is a substantial portion, thus labourers are to be excluded from partaking in Quality Circles. Index Average value for this question was 3.281 (Neutral).
- [8]. It was found that the organisational culture of the construction industry in India is partially unsupportive to the effective functioning of Quality Circles. This is concluded as 53.12% of respondents said their superiors would not consider their suggestions to solving a problem simply because the difference in designation. Index Average value for this question is 3.281 (Neutral)
- [9]. Also the temporary nature of teams formed on construction projects was found to be a challenge to the application of Quality Circles. 40.63% of respondents agreed that team dynamics would be affected, while 37.5% remained neutral. The Index average value of this question was 3.281 (Neutral)
- [10]. From the opinions of the respondents, there were 21 out of 23 (91.3%) conditions which proved to show favor towards the application of Quality Circles to construction projects while only 2 conditions proved to be a hindrance. From this we can conclude that Quality Circles have high applicability to construction projects.

5.2 Discussions

Quality Circle is an alien concept to the construction as it is native to the production industry. This is the reason the questionnaire survey conducted consisted of questions which asked respondents for their opinions of the granular characteristics of Quality Circles.

On being introduced to Quality Circles through the brief introduction to the topic provided on the cover sheet of the

questionnaire, about 56.25% of all respondents understood the concept immediately, whereas time was taken by the researcher to verbally explain the concept to the remaining 43.75% of respondents, after which they too understood the concept. Thus one of the main objectives of this research being, to raise awareness about Quality Circles as an effective program to improve the quality of construction, was accomplished.

Upon understanding the concept of Quality Circles and its mechanics, most of the respondents said that they would like to be a part of a Quality Circle team. Thus this shows us the wide acceptance of this program by all the different hierarchical levels involved in the survey, thus accomplishing one of this research's initially stated objectives. All the respondents who fell into the category of Top and Middle level management took a liking towards the concept of Quality Circles and said they would recommend the initiation of Quality Circles on a current or future construction. As these hierarchical levels are the main decision makers with regard to any construction project, their willingness to recommend initiation of Quality Circles can be taken into serious consideration.

Most time receiving permission from the management towards implementing a solution that is generated by the Quality Circle team, becomes a time consuming process especially with regard to simple, minor changes. Majority of the respondents said that foreman and supervisors are allowed to make minor changes on the construction site. Thus aspect proves to work towards the advantage of Quality Circles in the construction industry as compared to other industries as the stage of obtaining permission from the management is by-passed as, the technical personnel are already given the authority to make changes as they see fit. This saves a large amount of time in implementing of solutions generated.

About half of the respondents were of the opinion that there are designation biases at their organisations. This is because they felt that someone of higher designation than them might not be accepting of a solution to a problem suggested by the respondent simply because they are of lower designation. Thus this suggests that the organisational culture of the construction industry in India is very different than that of Japan and other eastern countries where Quality Circles originated and thrive even in the construction industry. Thus this is a big challenge that must be over-come at least on an organisational level, if Quality Circles are to be implemented effectively.

Especially since participation needs to be intrinsically motivated, unless all the members within the Quality Circle (be it Top Management personnel or Technical support personnel) are supportive of good opinions and critical of inefficient ideas while still being respectful towards each other, the program cannot be successful.

About half of the respondents were of the opinion that teamwork is affected if a member of their team were to exit the construction project or be replaced. This suggests that the temporary nature of the construction project teams could be a challenge towards the application of Quality Circles as it would affect the team dynamics when a person leaves the Quality Circle team or is to be replaced.

This research can be concluded by saying, the construction industry provide various conditions which are favorable to the implementation of Quality Circles as a program to improve the quality of construction projects. Despite being alien to the construction industry, this research has brought of the immense potential and scope which Quality Circles have in the Indian Construction industry. Although there are certain significant challenges that might be faced while intending to initiate a Quality Circle on a construction project, if it is done under a supportive organisational culture, it could prove to be an immensely efficient yet economic program to improve quality of any construction project.

5.3 Future Scope of Work

The respondents' opinions show that Quality Circles have high applicability to construction projects and that construction personnel are accepting towards new quality management practices like Quality Circles. Thus future research can be conducted by trying to implementing Quality Circles on construction projects.

There can also be further research done to correlate the different factors that affect the proper implementation of Quality Circles. Further opinion based research can be done in order to understand the changes and improvements seen on a construction project after that implementation of a Quality Circle.

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-Dominic Savio Roberts

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