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A Study of Various Strategies of Quality Management System Implementation in Construction Industries

Vidya Sidramagouda Patil[1]* Dr. Vikas Chauhan[2]

[1]Ph.D. Research Student, MUIT, Lucknow

[2]Research Guide, MUIT, Lucknow

Abstract – The best quality, time and cost are the important aspects of successful construction project which fulfills the main goal of construction industry. The quality management has to provide the environment within which related tools, techniques and procedures can be deployed effectively leading to operational success for a construction project. The role of quality management for a construction company is not an isolated activity, but intertwined with all the operational and managerial processes of the construction project. The quality management system (QMS) in construction industry refers to quality planning, quality assurance and quality control. The study includes the outcome of the research methodology decided by authors based on interview of project participants and analysis of scrutinized interview data.

The researchers have recommended a proposed Quality Management System for Construction Site aiming: firstly to raise the quality level of works in construction projects, and secondly to improve the construction staff consciousness, in different managerial levels, about quality management concepts and its importance for improving the quality of construction works. The researchers have come out with certain conclusions, above all is that this proposed quality management system for construction site will improve conducting quality management concepts in achieving construction works by construction companies.

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INTRODUCTION

Quality control and safety represent increasingly important concerns for project managers. Defects or failures in constructed facilities can result in very large costs. Even with minor defects, re-construction may be required and facility operations impaired. Increased costs and delays are the result. In the worst case, failures may cause personal injuries or fatalities. Accidents during the construction process can similarly result in personal injuries and large costs. Indirect costs of insurance, inspection and regulation are increasing rapidly due to these increased direct costs. Good project managers try to ensure that the job is done right the first time and that no major accidents occur on the project.

Quality is a relative term, which means different things to different people; some people would define it as excellence associated with an item. This definition seems inadequate for a construction project though, when one takes into consideration that designs quality, for example is measured by the 'conformance to client's brief'.

Performance on a global level represents results of activities. According to Naoum (2009), performance of a project is measured as its ability to deliver the building at the right time, cost and quality as well as achieving a high level of client satisfaction. Quality performance in construction is results oriented, and seeks evidence of quality awareness within the operations and output of a contractor. Quality performance is also defined over the long term for the effects to be permanent (Yasamis, Artiti and Mahammadi, 2002). In other words quality performance improvements are expected to increase the productivity and profitability of contractors, as well as increasing client satisfaction.[4,5]

The quality performance of a contractor at the project level includes the quality of the constructed facility as well as the quality of the contracting service. This according to Yasamis et al (2002) involves:

- Product delivery performance (technical competence and conformance to

specifications the contractor demonstrates during the construction process).

- Service design performance (competence with which the contractor carries out the construction planning activities).
- Service delivery performance (construction management and contract administration skills demonstrated by contractor during the construction process).

Globally, construction industry is one of the largest contributors to the Gross Domestic Profit (GDP) of any country. The construction projects has increased rapidly in the recent years, reflecting the interest of private and public sector investing more funds into property development. As the investment has increased the expectation of quality product has also increased. Now quality management has become an integral part of construction. Acknowledging the quality issues in construction and increasing demand for quality products, specific regulations to the implementation of the Quality Management Systems have been framed. ISO 9001 standards were set up for this purpose.

The results of a survey on Quality in construction by FIDIC has clearly indicated that the failure in construction quality is a big problem worldwide. In order to attract customers, ISO certification has become a trend in most industries including construction industry. According to ISO organisation, 178 Countries are ISO members, 3335 technical bodies are responsible for standards development and 1.1 million certificates are issued across 178 Countries and Economics. By the end of the year 2013, nearly 37,958 organisations in India had adopted ISO 9001 certification. The QMS which is being implemented are based on the ISO 9000 series of standards. ISO 9001 is one such standard .The important clauses in ISO 9001 for quality implementation are quality management system, management responsibility, resource management, product realization and measurement, analysis and improvement. Quality Management in construction project means maintaining the construction quality to the desired level of the customer.

Assurance, Quality Control, Quality Plan and quality improvement are the terms associated with quality management. A quality system is defined as the organizational structure, procedures, processes and resources needed to implement quality management. ISO 9001 specifies certain set of quality system requirements which has to be followed to meet customer satisfaction.

Quality Management has increasingly been adopted by construction companies as an initiative to solve quality problems and to meet the needs of the final customer, if ever an industry needed to take up the concept of QMS (Quality Management System) in the construction industry. However, implementing QMS principles in construction industry is particularly difficult because of the many parties involved.

The concept of quality has played a significant role in the business management literature since the improvements in production and product quality for a global market began in Japan in the 1950s. During the last decade, many construction firms have been critically challenged to achieve higher and superior quality on their projects and in recent years more attention has been paid to implementing and improving quality management in the construction sector.

However, due to the high cost of poor quality on many construction projects, additional research is still required to provide a framework for improvement of project quality outcomes. Quality management philosophies have been Manuscript received October 21, 2011; revised November 17, 2011. This work has been undertaken as part of an ongoing PhD research in the School of Urban Development, Faculty of Built Environment and Engineering, Queensland University of Technology.

Therefore, the development and establishment of more effective communication methodology between project participants and construction producers, in order to better align quality management actions in the construction industry both to meet the stakeholder view of quality as well as complying with specifications, is clearly one potential benefit that can result from further research and development at the present time.

The Construction industry of India is an important indicator of the development as it creates investment opportunities across various related sectors. The construction industry has contributed an estimated 6708 billion to the national GDP in 2011-12 (a share of around 8%). The industry is fragmented, with a handful of major companies involved in the construction activities across all segments; medium sized companies specializing in niche activities; and small and medium contractors who work on the subcontractor basis and carry out the work in the field. In 2011, there were slightly over 500 construction equipment manufacturing companies in all of India. The sector is labor-intensive and, including indirect jobs, provides employment to more than 35 million people.

Construction industry covers a wide range of projects and every construction project is unique in nature as it involves myriads of interrelated activities, tasks and work packages (Chris, 2009). With these complexities, construction is observed as the most adverse business among many industries. Therefore, construction projects have commonly suffered from high fragmentation, large waste, poor productivity,

cost and time overruns as well as enduring conflicts and disputes (Xue et al, 2005).

In a rapidly changing business industry, construction industry needs to be adaptable to new environments to maintain its competitiveness and core business as well as to improve its performance (Chang and Shen, 2009). In line with this streamlining effort, many scholars have studied several innovative management and procurement systems in construction industry including partnering, joint venture, alliances, supply chain management, enterprise resource planning (ERP), just in time (JIT) and total quality management (TQM) (Whyte and Lobo, 2010).

However, most of these management strategies have been originated and developed solely from other industries, especially manufacturing industry. Thus, adopting these concepts into the construction industry is something new and is considered challenging due to the nature of the construction industry especially the fragmentation embedded throughout its processes. In an effort to comprehensively reform the traditional business process, construction industry must strengthen its collaboration, integration, communication and coordination throughout the process, thereby improving the effectiveness and efficiency of its operation. Hence, coordination should be developed and managed in construction with its intention to ensure project success.

QUALITY/QUALITY CONTROL

Quality can be defined as meeting the legal, aesthetic and functional requirements of a project. Requirements may be simple or complex, or they may be stated in terms of the end result required or as a detailed description of what is to be done. But, however expressed, quality is obtained if the stated requirements are adequate, and if the completed project conforms to the requirements.

Law defines quality in terms of professional liability, a legal concept that requires all professionals to know their trade and practice it responsibly. Every architect and engineer who offers his or her expertise to owners is subject to professional liability laws.

Some design professionals believe that quality is measured by the aesthetics of the facilities they design. According to Stasiowski and Burstein, ~ this traditional definition of quality is based on such issues as how well a building blends into its surroundings, a building's psychological impacts on its inhabitants, the ability of a landscaping design to match the theme of adjacent structures, and the use of bold new design concepts that capture people's imaginations. Because aesthetic definitions of quality are largely subjective, major disagreements arise as to whether quality has been achieved or not. Since objective definitions of aesthetic quality do not exist, design professionals generally take it upon themselves to define the aesthetic quality of their designs.

Quality can also be defined from the view point of function, by how closely the project conforms to its requirements. Using this definition, a high quality project can be described by such terms as ease in understanding drawings, level of conflict in drawings and specifications, economics of construction, ease of operation, ease of maintenance, and energy efficiency.

In the construction industry, quality can be defined as meeting the requirements of the designer, constructor and regulatory agencies as well as the owner. According to an ASCE study, 2 quality can be characterized as follows.

- Meeting the requirements of the owner as to functional adequacy; completion on time and within budget; lifecycle costs; and operation and maintenance.
- Meeting the requirements of the design professional as to provision of well-defined scope of work; budget to assemble and use a qualified, trained and experienced staff; budget to obtain adequate field information prior to design; provisions for timely decisions by owner and design professional; and contract to perform necessary work at a fair fee with adequate time allowance.
- Meeting the requirements of the constructor as to provision of contract plans, specifications, and other documents prepared in sufficient detail to permit the constructor to prepare priced proposal or competitive bid; timely decisions by the owner and design professional on authorization and processing of change orders; fair and timely interpretation of contract requirements from field design and inspection staff; and contract for performance of work on a reasonable schedule which permits a reasonable profit.
- Meeting the requirements of regulatory agencies (the public) as to public safety and health; environmental considerations; protection of public property including utilities; and conformance with applicable laws, regulations, codes and policies.

In addition, one should differentiate between 'quality in fact' and 'quality in perception'. The providers of services or goods that meet specifications achieve quality in fact. A service or product that meets the

customer's expectations achieves quality in perception. 3 In other words, a product can be of high quality and yet it may not meet customer's needs and vice versa. An example of not meeting customer needs is the prefabricated high-rise apartment buildings that were built in the 1970s using cutting edge technology in low-cost building processes. The buildings had to be pulled down in the late 1980s because no one wanted to live in these apartments despite the low rents. The buildings failed to meet the tenants' expectations of comfort, aesthetics and function.

One should also differentiate between 'product quality', i.e. the quality of elements directly related to the physical product itself, and 'process quality', i.e. the quality of the process that causes the product to be either acceptable or not. 4 For example, 'product quality' in the construction industry may refer to achieving quality in the materials, equipment and technology that go into the building of a structure, whereas 'process quality' may refer to achieving quality in the way the project is organized and managed in the three phases of planning and design, construction, and operation and maintenance.

The terms quality assurance (QA) and quality control (QC) are frequently used interchangeably. Since quality control is a part of quality assurance, maintaining a clear distinction between then is difficult but important. Quality assurance is all planned and systematic actions necessary to provide adequate confidence that a structure, system or component will perform satisfactorily and conform with project requirements. On the other hand, quality control is a set of specific procedures involved in the qualityassurance process. These procedures include planning, coordinating, developing, checking, reviewing, and scheduling the work. The quality control function is closest to the product in that various techniques and activities are used to monitor the process and to pursue the elimination of sources that lead to unsatisfactory quality performance. Most design-related quality assurance and quality control activities are covered by a design organization's standard office procedures.

Developing and monitoring the activities within the quality assurance program in the construction phase are the responsibility of either the designer or the construction management firm depending on the project delivery system in use.[23] Establishing the project requirements for quality begins at project inception. A careful balance between the owner's requirements of the project costs and schedule, desired operating characteristics, materials of construction, etc. and the design professional's need for adequate time and budget to meet those requirements during the design process is essential. Owners balance their requirements against economic considerations and, in some cases, against chance of failure. The design professional is obligated to protect public health and safety in the context of the final completed project. The constructor is responsible for the means, methods, techniques, sequences, and procedures of construction, as well as safety precautions and programs during the construction process] Project requirements are the key factors that define quality in the process of construction. The process of construction can be broken down into three main phases, namely, (1) the planning and design phase, (2) the construction phase, and (3) the maintenance and operation phase. Figure 4 shows generally accepted elements of TQM and construction industry-specific factors that affect quality of the process of a building project.[24]

QUALITY MANAGEMENT SYSTEMS IN CONSTRUCTION

The sub-sections below introduce the general concept of quality and quality management system (QMS), in the context of the construction sector perspective; also introduced are the essential concepts of one of the well-known QMSs, the ISO 9001 standard. The two concepts are reviewed to contextualize the extent and significance of these research topics. Accordingly, the effectiveness of implementing QMSs and barriers to implementing the quality system are also justified.

Quality Defined in Construction -

With regard to any examination of quality issues in the construction industry, there are commonly three main terms that require objective definition and discussion. They are - what is actually meant by „quality", „quality management system (QMS)", and what constitutes a „total quality management (TQM)" philosophy.

There is no precise or single definition of „quality", and although many of the pioneers of the quality movement and gurus, such as Deming, Juran, Crosby, Feigenbaum, Taguchi and others, had their own individual definitions of „quality", ISO DIS 9000:2000 generally defines „quality" as "the degree to which a set of inherent characteristics fulfill requirements" (Tricker 2008). This means that in the construction industry, quality appears to be achieved whenever the needs of all those entities and individuals involved in projects or production or provision of services, such as consultants, constructors, project customers, and other related stakeholders, are fulfilled. Indeed, understanding the main concepts of quality is essential for a construction company in implementing a „quality management system" as a strategic management tool to gain benefits from the successful implementation of a quality system. [25]

Quality has a number of components, and a focus on only one aspect may result in a loss of customers

(Center for the Advancement of Process Technology 2011). The application of a QMS in order to consider the important aspects of the quality, is one of the key quality concepts reviewed by the writers on quality, these quality concepts including the following:

(1) a management commitment to reflect that quality issues‟ must start from the top;

(2) management systems to ensure consistency of operations;

(3) the use of statistics as the tool to run and evaluate processes as efficiently as possible;

(4) team work; and

(5) training to provide teams with the required knowledge of management systems, statistics, and improvement methodologies.

In an attempt to employ quality as a key component of the success of construction businesses today, many researchers state that it requires a well-implemented QMS in order to ensure the effectiveness of the QMS (Soetanto and Ganjian 2010).

Total Quality Management (TQM) is generally considered to be a higher level concept of strategic achievement than that provided by a QMS. McGregor and Palmer (2002) view TQM, firstly, as an approach to ensure that a whole organisation is involved in producing high quality outcomes in everything they do; secondly, in improving the continuous implementation of quality management; and finally, in achieving the primary objective of the concept, that of customer satisfaction. Based on these objectives and guidelines for providing continual improved quality management in construction companies, an effective TQM-based set of values is also an essential requirement for services‟ providers, to generate qualified activities and achieve the desired outcomes.

ISO 9001 Standard -

Quality control systems were originally developed from United Kingdom (UK) nuclear and military standards, and then rolled out as BS5750:1979 in the manufacturing industry. It was much later (in the 1980s and early 1990s) that the systems were adopted by UK construction companies to meet local and national government requirements for the construction industry, when companies were required to have certified quality systems in order to take up offered bidding opportunities.

The ISO 9000 series has now become the QMS model recommended by the followers of the quality movement as a benchmark for implementation of good management and process control in a variety of industries and sectors (Wahid, Corner and Tan 2011).[29] The model has been particularly widely adopted by the construction industry (Watson and Howarth 2011). The first series of ISO 9000 developed by the International Organization for Standardization-Technical Committees (ISO-TC 176) in 1987, was updated in 1994 and 2000, with the latest version of this standard being ISO 9001:2008. The 2008 version did not introduce any major changes relative to the 2000 version, and therefore does not require the re-writing of quality documents to suit the most recent version. The ISO 9001 standard is actually a generic one, which can be used successfully in construction companies and on their projects, even though every project is unique and involves different sub-contractors and suppliers.

The QMS-ISO 9001 standard is made up of five main clauses and 23 sub-clauses, each of which contains requirements that should be fully implemented to gain the potential benefits from the adoption of the system. There are 20 elements of ISO 9001 which are used as the basis of ISO 9001:1994. These elements have been replaced by five clauses for undertaking quality processing. However, the twenty elements are clearly identifiable within the process-based approach for implementing ISO 9001:2008 (Watson and Howarth 2011).[30] The twenty elements have been adapted for construction procedures to cover a wide scope of quality related activities of construction-related firms, as QMS elements to meet construction organisation and project conformity needs. In developing and maintaining ISO 9001, the collective experience and knowledge of international experts relating to ISO-TC 176 has been used for the development of the eight major quality management principles embedded in the ISO 9001 standard, that can be used by management as a basis for improving an organisation‟s performance. These eight quality management principles are:

1. **Customer focus -** The company focuses on customer requirements and expectations.

2. **Leadership -** The leaders establish unity of purpose and direction of the company.

3. **People involvement -** Employees are fully involved and their abilities are empowered for the company‟s benefit.

4. **Process approach -** Project activities and related resources are managed as a process.

5. **Systems approach to management -** The company identifies, understands, and manages interrelated processes as a system.

6. **Continual improvement -** The company has a strategic objective for permanent and continuous improvement of overall performance.

7. **Factual approach to decision making -** Decision-making is based on an analysis of relevant data and information.

8. **Mutually beneficial supplier relationships -** The company and its suppliers have interdependent and a mutually beneficial relationship.

ELEMENTS OF QUALITY CONTROL

One way of distinguishing the elements of quality control shows that there is a classification of four natural elements. This classification is:

1- New Design Control;

2- Incoming-Material Control;

3- Product Control;

4- Special Product Studies.

New Design Control-

Through the first element, the quality control effort on a new product is being conducted, while its marketable characteristics are being selected, the design parameters are being established and proved by prototype tests and the manufacturing process is being planned and initially costed. While the quality standards are being specified, both the product and process designs are reviewed to eliminate any possible sources of quality troubles which may appear before the start of a formal production and to improve maintainability and eliminate any threats to product reliability.[31]

Incoming-Material Control-

The second element represents the procedures for actual acceptance of materials, parts and components that are purchased from other companies or, perhaps, form other operating units of the same company. Occasionally, incoming material control applies to the parts that are produced in one area of a factory to be used in another area of the same factory.

Product Control-

The product control element involves the control of products at the source of production so that departures from quality specifications can be corrected before detective products are manufactured. It does not only involve the materials, but also the control of processes that contribute to the quality characteristics during the manufacturing operation. This control seeks to deliver a reliable product that will perform satisfactorily during its expected life and under the conditions of use.

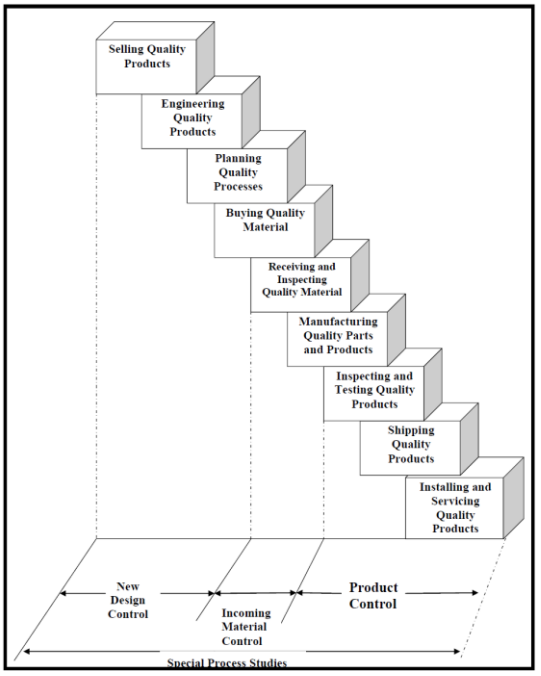

Figure 5: Quality control activities during the production cycle.

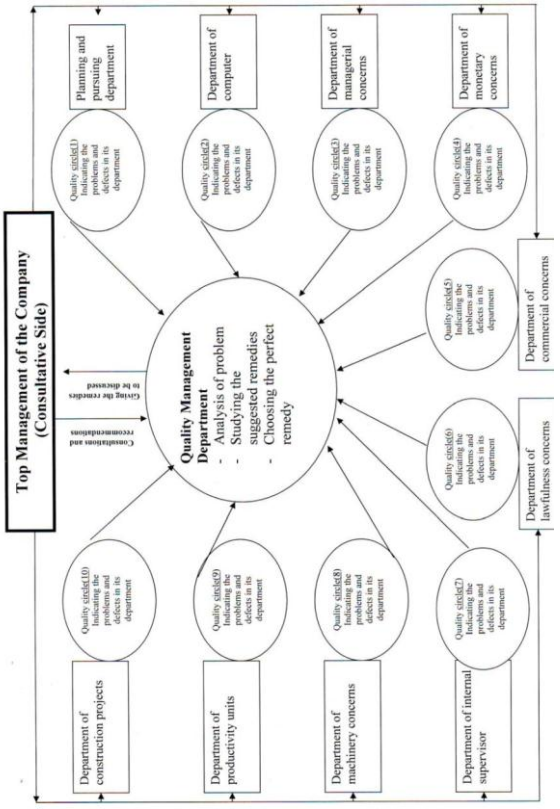

Figure 6: The relationship between quality circles and quality management department in construction companies.

Special Product Studies-

The last element of quality control is concerned with investigations and tests to allocate the causes of defective products. Elimination or control of these causes results in product and process improvement, not only improving the quality characteristics, but also reducing the cost of production.

QUALITY MANAGEMENT REQUIREMENTS FOR CONSTRUCTION PROJECTS

The contractor (one of the parties in the project contract) is responsible for planning and developing a program, which assures that all his management and technical responsibilities for achieving quality are effectively executed at the site. The program is aimed primarily to ensure an efficient quality control system at the construction site and take corrective actions, when necessary. The project management team PMT must be responsible for applying the quality control requirements at the site. The requirements are concentrated in three main points; these points are as follows (Columbus and Spite, 2004):

1- Quality Assurance Program;

2- Suitable Organization;

3- Necessary Quality Assurance Documents.

Quality Assurance Program-

The contractor's quality management team shall plan, establish, implement and maintain an efficient quality assurance program that complies with the requirements of work quality.

Suitable Organization-

The contractor has to organize some limitations and instructions to the quality control working staff on the shape of organizational measures. These limitations and instructions can be explained as follows (Burati et al., 2002):[34]

- Clearly define the management policies, objectives and responsibilities for quality assurance, including the responsibilities of each division within a multidivisional organization.
- Appoint a representative who shall report regularly to the quality control to ensure that the quality assurance requirements are not subordinated to design, manufacturing, construction or delivery, and define his authority to resolve quality matters.
- Use competent persons for inspection, other than those performing or directly supervising the work being inspected unless specifically designated otherwise in the quality plan. Generally, inspectors shall verify the conformance to the specifications and drawings. In cases of problems or difficulties, they shall request clarifications from the design or other competent organizations and initiate appropriate measures.
- Define the responsibility and authority for quality of those managing and performing the work and of those verifying conformance to quality requirements, and show their relationships on organization charts.
- Define the responsibility and authority of personnel who are primarily responsible for quality control and their organizational independence during audits.
- Assure that the inspection and quality control personnel report to an adequate level of management, excluding direct report to supervisors responsible for producing the work being inspected.

Quality Assurance Documents-

The constructor and his working team are responsible to prepare the following documents, which will be used as standards to control the work at the construction site:

1- Quality Assurance Manual;

2- Quality Plan.

Quality Assurance Manual- The constructor shall;

1. Prepare a quality assurance manual, approved and signed by a senior management official, and submit it for the client's concurrence before the contract is awarded or at the latest before the site work is started.
2. Review and update the manual to reflect current quality assurance policies and procedures and resubmit the revised and updated manual.
3. Implement the quality assurance program according to the provision specified in the manual.

The quality assurance manual shall deal appropriately with the following (Feigenbaum, 2007):

a- **Organization**- The manual shall define the organizational measures as specified in the suitable organizational article.

b- **Quality plan**- The manual shall identify the group responsible for the quality plan specified in the following article and define its main principles and features in adequate procedures.

c- **Quality assurance procedures** – Documents of QA procedures shall be included or outlined and cross- referenced. Referenced QA procedures shall be made available to the quality assurance representative.

d- **Quality Plan-**Quality plan can be considered as a work program organized by the constructor and the quality control staff. All the tests and inspections for any construction projects are expected to be explained in this plan. To prepare the plan, the constructor shall (Simmons, 2001):

1) Plan the inspections and test activities;

2) Identify in the quality plan that the inspections and tests to be performed on the items are listed in the contract in compliance with contractual and/or technical condition requirements;

3) Submit the plan for the client's concurrence following the award of the contract and before the work start;

4) Up-date the plan during the project life to reflect the current conditions of manufacturing, construction, inspecting and testing and resubmit the plan to the client.

The quality plan may be of any format to suit the execution approach that has been followed by the constructor. The quality plan shall deal as appropriate with;

a- Identification of the characteristics or items to be inspected and tested;

b- Identification of required inspection, tests and special process operations and their relative locations in the construction cycle;

c- Identification of hold points beyond which the activity shall not proceed until the required inspections or tests have shown satisfactory results and been documented;

d- Provisions for the client to insert witness points at which activities are to be observed.

The quality plans for subcontracted items or service, when are concurred by the contractor, shall be submitted to the client, as applicable, for concurrence and insertion as witness points.

CURRENT SITE QUALITY MANAGEMENT SYSTEMS OF CONSTRUCTION PROJECTS

A field survey has been carried out, by the researchers, on thirty project managers and thirty constructors, to identify and evaluate the current site quality management systems used for controlling the quality of site works of construction projects. The answers were then; collected, tabulated and analyzed to be discussed. The discussion of the answers has come out with the following points:

1. The absence of quality management in the constructing companies was the main reason which had made most of the answers indicate that the best starting point for applying quality management works is at the design stage, in order to ensure the decrement in fault rates in all construction project stages to the minimum level.

2. The analysis of the data collected from the questionnaires showed that the work size which had been re-executed because of faults in the project's requirements such as; contract conditions, design, specifications …etc. was huge. The reason of these faults is the absence of an integrated monitoring system through which these faults can be prevented as early as possible.

3. According to the analysis results, quality management in the contracting company's head office is responsible for determining the faults in the project's requirements, especially in; design, bill of quantities and specifications before their arrival to the contractor hand at the site. From the researchers' point of view and depending on the questionnaire participants' opinions, quality control works are series of conjugated works starting from the planning stage till the commissioning stage.

4. The achievement of a successful TQM system occurs through a complete understanding of the top management to this system, in addition to its success dependancy on the managerial participation of all parties involved in the construction projects. So, this participation will continuously support the quality management processes by making them permanent works in construction

companies. That was the researchers' opinion based on the opinions of managers and contractors who participated in the questionnaire.

5. The questionnaire's answers indicated that most of participants agreed that the benefit of TQM system is to develop the work performance and to participate in creating a state of competition between construction companies, so that this competition will assist in developing the construction industry through rising the quality level of construction work executed by these companies.

6. According to the managerial engineers' opinions, the required period for achieving the TQM system at the head office is less than that required at the construction site, as this system is facing so many difficulties at the site in comparison to the head office.

7. The questionnaire's results showed that there is a lack in applying quality management, and the achievement of such is usually depending on the construction staff. Meanwhile, the site quality control is limited by laboratory tests of some construction materials. Most of the constructors' answers agreed on the importance of an independent quality management system, through which the achievement of early detection of site faults will be obtained in order to prevent any delays, extra costs or site problems.

8. The application of an independent control system for site quality has a direct effect on the companies and their site staff. Regarding the company, the benefit is represented by a continuous watching of site works' quality in order to get a rapid determination of the construction faults.

9. The main reason for not applying the independent management system for site quality is the lack of knowledge of the elements and the requirements of the TQM system, in addition to the poverty of financial support to such system. In spite of that, the questionnaire's answers indicated that there is a strong desire of the companies' top managements towards applying an independent management system which concerns site quality.

QUALITY IMPROVEMENT TECHNIQUES

Total Quality Management mainly demands a process of continued improvement aimed at reducing variability. An organization wishing to support and develop such a process needs to use quality management tools and techniques. It is prudent to start with the more simple tools and techniques. These are Check-sheet, Check list, Histogram, Pareto Diagram, Cause-and-Effect Diagram (Fishbone Diagram), Scatter Chart and Flowchart.

Check-sheet - Check-sheet is used to record events, or non-events (non–conformances). They can also include information such as the position where the event occurred and any known causes. They are usually prepared in advance and are completed by those who are carrying out the operations or monitoring their progress. The value of check-sheet can be retrospective analysis, so they help with problem identification and problem solving.

Checklist - Checklist is used to tell the user if there is a certain thing, which must be checked. As such, it can be used in the auditing of quality assurance and to follow the steps in a particular process.

Histogram - Histogram provides a graphical representation of the individual measured values in a data set according to the frequency of occurrence. It helps to visualize the distribution of data and there are several forms, which should be recognized, and in this way they reveal the amount of variation within a process. It should be well designed so that people who carry out the operation can easily use them.

Pareto Analysis - It is a technique employed to prioritize the problems so that attention is initially focused on those, having the greatest effect. It was discovered by an Italian economist, named Vilfredo Pareto, who observed how the vast majority of wealth (80%) was owned by relatively few of the population (20%). As a generalized rule for considering solutions to problems, Pareto analysis aims toidentify the critical 20% of causes and to solve them as a priority.

Cause and Effect Diagram (Fishbone Diagram) - Cause and Effect Diagram, which was developed by Karoa Ishikawa, is useful in breaking down the major causes of a particular problem. The shape of the diagram looks like the skeleton of a fish. This is because a process often has a multitude of tasks footing into it, any one of which may be a cause. If a problem occurs, it will have an effect on the process, so it will be necessary to consider the whole multitude of tasks when searching for a solution.

Scatter Diagram - The relationship of two variables can be plotted in the scatter diagrams. They are easy to complete and obviously linear pattern reveals a strong correlation.

Flowcharts - Flow chart is used to provide a diagrammatic picture using a set of symbols. They are used to show all the steps or stages in a process project or sequence of events. A flowchart assists in documenting and describing a process so that it can be examined and improved. Analysing the data collected on a flowchart can help to uncover irregularities and potential problem points.

Statistical analysis - Statistics is the study of the collection, organization, analysis, interpretation and presentation of data. It deals with all aspects of data, including the planning of data collection in terms of the design of surveys and experiments.

PDCA cycle - PDCA is an iterative four-step management method used in business for the control and continuous improvement of processes and products. It is also known as the Deming circle/cycle/wheel, Shewhart cycle, control circle/cycle, or plan–do–study–act.Another version of this PDCA cycle is OPDCA. The added "O" stands for observation.

BUILDING QUALITY INTO CONSTRUCTION PROJECTS

Construction is defined as 'the mobilisation and utilisation of capital and specialised personnel, materials, and equipment to assemble materials and equipment on a specific site in accordance with drawings, specifications, and contract documents prepared to serve the purposes of the client'. As a sector, the construction industry accounts for 10% of the UK's GDP (DTI, 2005), has an output of more than £80 billion and employs around 1.4 million people – figures that reflect its importance.

When carrying out construction projects, professionals with different backgrounds are brought together at various points to fulfil the customer's requirements. This gives rise to different problems because these professionals tend to work in isolation, while making decisions that affect one another. In addition, there are characteristics of the construction industry (Walker, 2002) that can adversely impact quality and customer satisfaction, e.g. different weather and project each time, different team and arrangements for each project. Apart from quality problems, the industry also has performance difficulties, the main reasons for which, according to Koskela (2003), are the construction process and its peculiarities. In order to overcome these problems, it has been recommended that the industry adopt the concepts and methods that have been successfully implemented in manufacturing. In particular, the use of TQMhas been suggested. Some of the approaches reported in the construction management literature aimed at improving construction performance will be detailed and their limitations discussed. The main requirements of a framework are then established, followed by an explanation of how the framework was constructed, its main components and its advantages over previous approaches. Guidance on implementing the methods included in the framework are described and the expected outputs and main features highlighted.

Construction improvement initiatives A comprehensive review of the literature related to improvement initiatives in the construction industry revealed both similar and dissimilar aspects. The models of Formoso et al. (2002), for example, were aimed at clearly defining the construction participants' role in the product development process. In addition, key stages in the construction process were identified where communication problems were evident. To alleviate these, Kagioglou et al. suggested that documents be used for controlling project information. On the other hand, initiatives such as the Lean Project Delivery System Model (LPDSM), Serpell and Alarcon's (1998) methodology and the flow concept of the Transformation, Flow and Value generation (TFV) production theory were oriented more towards managing flows and reducing waste in the construction process than on defining participants and their roles. Flows play a key role in construction project management and they can, according to Womack et al. (1990), have a direct impact on customer satisfaction (a very simple example being that, if materials' delays were reduced, a project could be finished earlier than scheduled).

CONCLUSION

The success of QMS doesn't completely depend upon setting policies and maintaining documents. Though the top management are very good in leading the changes and setting policies, without proper communication and control of processes, the desired quality cannot be achieved in construction. If there is no proper monitoring and control, The ISO certification just becomes a marketing tool rather than a QMS implementation tool. The importance of Quality Representative at site has to be communicated to the lower management. There is a perception that QMS implementation increases paper work. The unwillingness of the employee to adopt QMS and inadequate technical expertise are other major factors faced during the implementation of QMS. Most of the quality issues faced elsewhere are relevant in local context. The correlation values are higher for appointment of representatives and Conducting reviews in case of management factors. Subcontractors work and inadequate technical expertise has greater correlation in issues in implementation of QMS. From the case study, every project has a specific quality plan. Though the same client is developing the property, they still follow separate project Quality Plans (PQP). Proper resource allocation with specific roles and responsibilities are pre-defined for every project. But they lack in monitoring of resources. Quality audits, progress reports, schedule etc. are used for quality

control. Quality audits and experiments designed are traditional methods for quality control. Customer feedback is received and suggestions for future improvement. Though ISO 9001 has established standards, the procedures and policies change for every project based on the requirements.

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Corresponding Author

Vidya Sidramagouda Patil*

Ph.D. Research Student, MUIT, Lucknow

E-Mail – vidyasp89@gmail.com