Total Quality Management in construction projects: a conceptual model of teamwork for achieving jobsite quality

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TOTAL QUALITY MANAGEMENT IN CONSTRUCTION PROJECTS - A CONCEPTUAL MODEL OF TEAMWORK FOR ACHIEVING JOBSITE QUALITY

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ABSTRACT

Total Quality Management (TQM) is a never ending improvement process aimed at customer satisfaction. It has been successfully applied in the manufacturing industry through a teamwork approach. The manufacturing process is repetitious, the workforce constant, and the environment is such that all parties involved in a process can work together towards a common objective. However, the construction industry is characterised by its one-off nature, where the workforce and processes often vary from project to project. The state of legal independence between participants and their traditional methods of working together are often an obstacle to adopting a team environment. However, these obstacles can be overcome when the partnering concept is introduced in the relationship between various participants. Partnering arrangements can greatly improve the interface between participants, and enable them to establish a Joint Management Team (JMT) that involves all participants in the process. This JMT focuses on operational goals, and co-ordinates all participants to provide support for the various processes. In order to achieve continuous improvement at the construction jobsite, the joint management team focuses on co-ordination and improvement activities, which include: encouragement; training; quality teams; and measuring and reviewing performance. When people and other resources involved in a project are properly managed through the joint management team, total project success becomes possible. This paper discusses the teamwork functions of the JMT for achieving quality at construction jobsite.

INTRODUCTION

The contents of this paper forms part of the research being conducted at the Loughborough University, in order to both: identify the most appropriate contractual arrangement for implementing TQM on construction projects; and to establish the best practices for the Client's Representative when implementing TQM. After a detailed review of current literature followed by preliminary interviews with construction industry, the "partnering arrangement" between project participants was identified as an ideal relationship for implementing TQM in construction. It also improves teamwork between participants to achieve improved site quality, and forms a basis for the development of a conceptual model.

Construction projects are becoming increasingly complex, and at the same time require input, involvement, and commitment from the Client, Contractors, Consultants, Suppliers, and Vendors for efficient use of resources, avoidance of errors, and productivity improvement. TQM provides a good environment for achieving all of these objectives. TQM focuses on two principles: continuous improvement and customer satisfaction. These two principles can be best achieved by the participants working together with a common goal. Since the construction process involves inputs from many participants, teamwork becomes essential and inevitable for improving jobsite quality. This paper, discusses the basic principles of TQM and the use of partnering for improving teamwork. It also presents a conceptual teamwork model suitable for the jobsite construction processes. The model describes how the participants work together towards the common goal for achieving improved site quality in construction projects.
TOTAL QUALITY MANAGEMENT (TQM)

Many definitions of TQM exist, however, most of these do coincide with the European Construction Institute's (ECI 1993) definition that states:

"Total Quality Management is a management led process to obtain the involvement of all employees, in the continuous improvement of the performance of all activities, as part of normal business, to meet the needs and satisfaction of the customer whether internal or external".

Customer satisfaction and continuous improvement are the fundamental goals of TQM and are thereby the principles on which it is based (Burati 1992). According to Oakland (1990), these goals require: total involvement of all employees; total management commitment; customer and supplier working together; and objectives, standards and systems which confirm to the commitment to total quality. These requirements insist on total involvement of and input from all participants in order to achieve customer satisfaction and continuous improvement. In TQM, quality is everybody's business, it can be achieved by: confirming to requirements; prevention not detection; getting it right first time; and measuring quality performance (Oakland 1994).

In order to achieve total quality, participants should therefore work together with a philosophy of 'prevention not detection'. However, traditional management systems often based on the policy of inspecting the work of others instead of participating in the process. However, checking is not totally eliminated, it is necessary for the prevention of errors, getting it right first time, and conforming to requirements. The 'inspection and detection' approach is replaced by a strategy of 'prevention'. This concentrates efforts on the front end of any process, and ensures that the inputs are capable of meeting the requirements of the process.

The 'inspection' strategy often leads participants to finding faults in the others work, resulting in defensive actions being taken. This approach reduces trust between the various participants, and disputes will continue as long as people fail to trust one another (The Dispute Avoidance and Resolution Task Force 1994). In order to avoid disputes, Latham Report (1994), commissioned jointly by the Government of UK and the construction industry, emphasises teamwork and partnership between participants. The report further describes that endlessly refining existing conditions of contracts will not solve adversarial problems. If the construction industry is to become less adversarial, contractual arrangement which place an emphasis on teamwork and partnership should be adopted. In addition, to avoid misinformation and errors, and at the same time facilitate the exchange of ideas for continuously improving the process, teamwork between the participants is essential. It provides an environment to identify, analyse and solve problems immediately.

PARTNERING - AN IDEAL APPROACH FOR TEAMWORK IN CONSTRUCTION PROJECTS

Construction involves many participants: the Client; Contractor; Designer; Sub-contractors; etc. All participants are responsible for the implementation of TQM within their own organisation, and thereby develop their staff and resources in line with skills and techniques needed for TQM. However, one of the main objectives of TQM implementation in the construction project is to achieve quality at site. Implementation of TQM solely within "individual organisations" will not necessarily enable them to achieve total quality on the construction site. The quality of the final product largely depends on relationships between parties involved in the project (i.e. the Client, Contractor, Sub-contractors, and Consultants etc.). The participants within the project organisation need to satisfy the needs of the next participants in the line who use their output. Both the Contractor and Owner need to share their objectives, resources, and techniques if a quality product is to be produced. Thus, they are required to work jointly towards a common goal, which requires more interactions and
interdependance between participants. Ultimately, this requires a cultural change away from the way participants traditionally work in the construction industry. One vehicle for achieving this changed culture could be selected from the various 'partnering arrangements'.

Partnering can greatly improve the interface between the Client and the Contractor, as well as project execution. It also provides an ideal environment to implement TQM. Chase (1993) interrelated TQM and Partnering as follows.

"On individual construction projects, the parties may establish a team environment in which the General Contractor, Subcontractor, Suppliers, Owner’s Representatives, and Designers all work together. Sometimes, this is the result of TQM; other times it is the result of partnering arrangement. Sometimes it is both."

What is partnering?

The Construction Industry Institute (CII 1991) defines partnering as a "long-term commitment between two or more organisations for the purpose of achieving specific project objectives by maximising the effectiveness of each participants' resources". According to CII, three key elements necessary for partnering are trust, long-term commitment and shared vision. Trust helps eliminate the traditional adversarial relationship between the participants. Long-term commitment helps reduce the learning curve for the participants in knowing each others’ principles and expectations. Shared vision is the mutual exchange of ideas between the participants, which helps the parties to accomplish the common goal successfully.

Crowley (1994) proposed a model of the 'partnering organisation' graphically illustrated in Figure 1. The figure depicts the boundaries which define and separate the three participants involved in a project - Owner/Client, Designer, and the Builder. In this structure, the individual organisations are illustrated within thick boundary lines, where the participants function separately for their own parent organisation. The partnering organisation shown within a hexagon 'pqrsut', where the participants work together with a common goal. This shows the project specific work, where the Owner/Client, Designer and Builder could establish a joint management team and work jointly within the limit determined by the joint team for a particular project. Consequently, partnering is a matrix of two overlaying organisations, one dealing with the project and the other with the parent organisation.

![Figure 1. A model of partnering organisation. Source: Crowley and Arifal Karim (1994)](image)
TEAMWORK FOR JOBSITE QUALITY - CURRENT PRACTICE

Recent teamwork practices adopted by the construction industry will be discussed prior to presenting a 'teamwork' model for improving construction works at site. The design and construction process involves a chain of activities which involves many people. For example, Owners provide input to the design process. The design process provides input to the construction process. Suppliers provide the raw materials necessary to construct the facility. This amalgamation of people, equipment, and processes forms a system to achieve the objective of the process. If this system is to work at its best, there should occur a sense of teamwork among all parties associated with the process.

Research conducted by CII (1991) and NEDC's (National Economic Development Council) Working party (1991) revealed that many of the companies involved in partnering arrangements had formed Joint Management Teams at a very early stage of individual project. According to CII and NEDC's Working Party, some of the major companies achieved jobsite teamwork through partnering concept are: DuPont/Fluor Daniel; Union Carbide/Bechtel; Proctor &Gamble/Kellogg; and Shell Oil/Parsons. Prior to forming a joint management team, these partners had conducted a pre-planning session, in which project participants such as the Client or his/her representatives, Contractors and Designers participated and provided their construction knowledge to jointly develop an implementation plan. Through this approach, all parties were informed of the Client's expectations and those of other parties. Input for design improvements was solicited from construction professionals, and quality expectations and implementation process were selected from previous experience. During the course of construction, the Joint Management Team played an active role in keeping all parties and teams together for achieving continuous improvement and customer satisfaction. The overall activities performed by the joint team includes: encouraging all parties to achieve customer requirements; maintaining all task teams functioning under co-ordination team; training the participants on quality and safety issues; and measuring and reviewing the performance for determining progress.

In May of 1992, the Construction Engineering Programme at Iowa State University held its third "Total Quality Management (TQM) in Building Design and Construction Workshop" in Dallas, Texas. According to Federle and Chase (1993), the main recommendations for the improvement of jobsite quality observed in the workshop include the following.

- Conducting pre-construction sessions in order to develop a clear understanding of all parties, and this session includes the Owner, Designer, Contractor and Sub-contractor.
- Conducting jobsite orientation for all employees. The orientation should address the concept of TQM, safety and quality improvement activities, etc.
- Conducting weekly planning meetings to outline work to be accomplished in the following weeks.
- Establishing work teams in each craft area to pre-plan their own work and determine resource requirements.
- Developing indicators of quality performance at site.
- Communicating quality expectations to the craft workers of all trades.
- Frequently surveying craft workers and requesting them to submit suggestions for improvement.
- Establishing quality-improvement teams in design and craft area.
- Providing training to all quality teams for continuous improvement.

The Joint Management Team forms the focal point for accelerating all the foregoing jobsite quality improvement activities. The participants work jointly together through the joint team,
and form various task teams to achieve jobsite quality in construction. These task teams operate under the Joint Management Team. Work teams are formed at various craft disciplines to look after their requirements and process improvements regarding their own business. The teams of all kinds are interlocked in such a manner that they participate in cross-functional activities.

TEAMWORK FOR JOBSITE QUALITY IMPROVEMENT: A CONCEPTUAL MODEL

Teamwork throughout any organisation is an essential component of the implementation of TQM, for it builds trust, improves communications and develops interdependence (Oakland 1994). When properly managed, teams improve the process of problem solving and producing results quickly and economically. Teamwork enhances the interdependence through improved communications and trust. This forms an important part of any quality improvement process.

According to Oakland (1994), Adair describes the team functions as: setting standards; maintaining discipline; building team spirit; encouraging; motivating; giving a sense of purpose; appointing sub-leaders; ensuring communication within the group; and training the group. These functions coincide with that of those performed by the Joint Management Team described in the previous section.

Teamwork for jobsite quality in construction should start with a pre-planning session conducted at the earlier stage of pre-construction phase. This session should include: Client; Contractor; Designer; and if possible the key Sub-contractors and Suppliers. Initially, a jobsite orientation should be conducted, including orientation to TQM, safety, introduction of all participants, and the quality expectations of the project. The team members should then exchange their own ideas, previous experiences, and expectations relating to the project. Finally, they could hold a brainstorming session for achieving a consensus on project mission. At the end of the session the members should jointly develop an implementation plan, and establish a joint management team. This team should then act as a steering team in implementing the established jobsite quality programme.

A proposed model of 'teamwork' is graphically illustrated in Figure 2. The previous discussions of partnering and teamwork approaches for achieving jobsite quality form the basis of the development of this model. In this model, the JMT (Joint Management Team) forms the teamwork spine. This team comprises the members from Client/Owner, Contractor, Designer, and if possible Sub-contractors, who are directly involved in the project. All members of the team should strive for continuous improvement and customer satisfaction through teamwork. The functions of the JMT for jobsite quality improvement are encapsulated within the spectrum of activities: encouragement; training; quality teams; and measuring and reviewing performance.

The main theme inherent in this model is that the JMT should: facilitate continuous improvement through a P-D-C-A (Plan-Do-Check-Act) cycle; encourage and train individual and teams for continuous improvement; and measure performance. Once this process is properly managed and developed by the JMT, then the teams of all kinds (including quality improvement teams, corrective action teams and other tasks teams) functioning at various levels of the management and craft, will help to achieve continuous improvement in their respective disciplines. In construction, everyone acts as supplier, customer and processor. For instance, the Designer receives the project brief from the Client, and processes and supplies the design to the Contractor. This shows that by receiving the Client brief, the Designer acts as a customer to the Client, and by processing and supplying the design he/she acts as processor and supplier. Similarly, the chain of processes involve a number of parties receiving a product or service one from the other (ie. internal customers). The receiver or user of the final product - the building - is the external customer. If processors at all levels achieve improvement in their own businesses, the result would be the overall jobsite quality
improvement. Once the specified quality is achieved at jobsite and all the internal customers are satisfied, then the external customer - the Client - would also be satisfied. This represents successful project implementation. The teamwork for jobsite quality is described under the four major activities - Encouragement, Training, Quality Teams, and Measuring and Reviewing Performance.

![Teamwork for Jobsite Quality Improvement Diagram](image)

**Figure 2: Teamwork for Jobsite Quality Improvement**

**Encouragement**

Encouragement promotes teamwork at the jobsite. Everyone involved in the process are made accountable for their own performance. This is achieved by recognising the high performers. The JMT discusses the various forms of recognition and recognises the highest quality performer for every week or month. Recognition may be in the form of the "crew or team of the month" award or rewards in the form of cash or prizes. Celebrations can also be used. When certain target is achieved, the people involved in that accomplishment can celebrate with some sort of social event. Achievements, successes and failures of the process can be posterized and displayed at all levels of jobsite, which encourage the participants to constantly work for improvement in their processes.

**Training**

Every innovative approach will need on-going continuous training. The JMT diagnoses the training needs of the teams functioning under the control of JMT, and accordingly provides them the necessary training. The training skills include: meeting skills; communication; process improvement; and problem solving. Team training usually takes two days. During the training sessions all teams should be given opportunity to solve sample problems before applying their new skills to the process. Similarly all teams functioning from top management to the craft level set their own training requirements, and train the individuals involved in their process on job-specific problems. Since construction process involves many participants, and the product or service supplied by each participant is received by the
next participant in the line who use their output, cross functional training should also take place between them. For instance, a supplier may train the customer on how to use his/her product or service, and in turn customer may train the supplier on his/her expectations on service or product to be supplied by the supplier.

Quality teams

The existence of quality teams are common to most quality management programmes. Many task teams such as quality improvement teams, corrective action teams, problem solving teams, education action teams are established. These teams are organised at all levels of construction processes. The JMT closely monitor the activities of all teams.

Each team selects its own leader, and establishes procedures and time intervals for conducting meetings. Team meetings are conducted by the team leader. The team leader has a primary responsibility for team management and maintenance (Oakland 1994). This responsibility requires many skills for the team leader such as communication skills, group dynamics, statistical methods, presentation skills, problem solving methods and techniques, and group leadership skills (Imai 1986). The membership of the quality teams includes appropriate individuals from groups outside the operational and technical areas directly 'responsible' for the problem, this makes a significant contribution to the improvement process, and satisfies the complexity of the various processes which require different skills from different people.

All quality teams follow Deming's (1986) P-D-C-A (Plan-Do-Check-Act) problem solving process for continuous improvement. Figure 3 depicts step by step problem solving process for the team members. The first step of this process is problem identification. At this stage, the magnitude of the problem, scale for measurement of the problem, and cost of the problem are analysed by the team members. All participants are then asked for their views and suggested solutions relating to the problem. After defining the problem, the team obtains suggestions from the JMT, it then identifies the root causes of the problem and suggests appropriate solutions to tackle the problem. During this stage, the team trains the respective personnel for solution implementation. Actual implementation is closely followed by the team by monitoring progress and ensuring that the solution actually solves the problem effectively. Finally, the team continuously tracks the problem to find solutions for improving the process. These problem solving process are applicable to all teams involved in the process including the JMT and craft level teams.

Measuring and reviewing performance

In order to assess and evaluate performance accurately, appropriate measures are designed, developed and maintained by people who own the processes concerned. These measures are converted into quality indicators, which help identify the progress being made against the measures. Examples of quality indicators in jobsite include: shop drawing turn around time (time required to complete the drawing and specifications); jobsite cleanliness and orderliness; non-conformance reports, rework; jobsite safety etc. (Federle 1993). Each team develops their own indicators to measure their own performance and demonstrate progress. The quality indicators are then displayed on the jobsite, which create awareness among and encourage the participants to achieve improvement.

The JMT regularly conducts meetings and checks the progress of the quality achievement in terms of the quality standards set at the pre-planning stage. The meetings cover the quality and safety aspects of the quality plan. All individuals and teams are allowed to present their own performance improvement and suggestions for further improvements regarding their processes. Individuals and teams are not blamed for failure to achieve standards and targets or for rework, instead, solutions are found out for preventing such failures in future. The JMT monitors the progress made by all kinds of teams involved in the project, and directs them for continuously improving the process.
CONCLUSION

There has been a growing awareness of the teamwork approach in construction industry. Various reports (CII 1991; NEDC's Working Party 1991; Latham 1994) suggested cultural changes involving teamwork. Achieving this cultural change is a challenging task faced by the construction industry. In order to achieve Total Quality Management, the JMT (Joint Management Team) approach is essential; it enables all participants to jointly work together with a common goal. The successful quality-based strategy that the project organisation adopting depends very much on effective leadership. In a partnering organisation, effective leadership starts with the JMT and exists at all levels, including the craft level. Together, effective leadership and teamwork result in the project organisation enhancing communication, and doing the right things, right first time. TQM focuses on continuous improvement and customer satisfaction. When staff and processes are properly managed and equipped through the 'teamwork' approach, the jobsite process should be improved, and consequently, the resulting product - the building - would satisfy the requirements of the Client.

REFERENCES