



Management of Safety for Quality Construction

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Abstract

An overview of construction quality and safety reveals many striking similarities for these two management concept. Programs that have been developed to improve quality and safety performance have many elements in common. In some cases safety is considered a part of Total Quality Management (TQM). The close relationship between quality and safety implies that benefits would be derived by applying some or all of the following propositions: (1) Consolidate the safety and quality functions; (2) Apply quality concept to safety; (3) Optimize the safety management concept; and (4) Apply the results of safety aspects to quality. Within these past few years, the Malaysian government has made an effort on executing safety and health policies through the enforcement of guidelines as well as conducting site safety seminars and certifications. Ranked as a second industry in Malaysia that contribute to highest percentage of accidents at the worksite, the impact of loss of profit and unhealthy workplace affect the construction industry. Currently, these topics are being widely implied and stressed out in Malaysia by the means of enforcement; for instance, through ISO certification and local regulations and guidelines. This paper aim to provide a basis framework, this seminar which titled "Safety Management towards Quality Construction" tries to delineate the relationship and the importance of these two areas. The concepts of safety management and quality management indeed are still new in Malaysia. A proposed model which is also a framework is seen as a procurable method on defining the basic concept of safety management meant to achieve the expected quality level. In the aspect of proposing safety application model, a directive method of the Total Quality Management is used. A basic management application model as suggested by Walker (1993), is proposed to be used as a generic model to highlight the key features. Findings from individual survey are used to delineate the key points or processes of the safety application model.

Keywords: Safety, Management, Quality, Construction, Industry

1. Introduction

The present Occupational Safety And Health (OSH) situation in the workplace is still very much adverse and below expectation. Accidents and diseases still occur and they are a cause for concern as the available statistics show that the percentage of accident occurs in the workplace is alarmingly increased (SOCISO, 2000) (Figure 1). Precedent analysis

done by Department of Occupational Safety & Health (DOSH) revealed that the number of accidents occur in this industry is very high. The management of health and safety is without doubt one of the most important functions within and throughout the construction process.

<Figure 1: Reported accidents in the construction industry from year 1995-2000 (SOCSO, 2000)>

A probe into the safety management system suggests that the current practise in Malaysia does have sound features and characteristics. However, it lacks the mission, vision and objectives of safety management system as well lack of awareness and drive for the realization of safety among management executives due to over-emphasis on productivity. It also requires more constructive and practical ideas towards safety management implementation. In contrast to the existing scenario, the quality practice in Malaysia is more developed and established in which the control measure can be seen from the enforcement of various guidelines, implementation of quality management and the establishment of specific body to monitor activities relating to quality management topic. Knowing the fact that improvement is vital and needed, a framework of safety management is formulated and adopted based on the intention of achieving quality construction. An integration of safety management and quality on brings forth a more comprehensive approach on safety practice whilst at the same time providing a quality construction.

The term 'safety management' actually is used for convenience and for brevity, and wherever it is used it should be taken to refer to the management of occupational health and the environment as well as safety. Safety management is concerned with, and achieved by, all the techniques which promote the subject. In addition, safety management is also concerned with influencing human behaviour and with limiting the opportunities for mistakes to be made which would result in harm or loss. As described in Occupational Safety and Health (OHSAS 18001), Occupational Health and Safety Management System (OHSMS) is:

"Part of the overall management system that facilitates the management of the OH&S risks associated with the business of the organization. This includes the organizational structure, planning activities, responsibilities, practices, processes and resources for developing, implementing, achieving, reviewing and maintaining the organization's OH&S policy." (Shamsul Efendi Dismal, 2002). The term 'safety management' as defined by World Health Organization (WHO) is: *"the process of enabling people to increase control over, and to improve their health."* (WHO 1990)

Quality has traditionally been interpreted as 'ability to satisfy needs' (BSI, 1971), 'conformance to requirements' (BRE, 1978), and 'fitness for purpose' (CIRIA, 1985). The recent trends have seen a more holistic understanding of quality emerging in terms of providing customer satisfaction. this orientation towards the customer has focused the attention of quality management as a process which links to the various stages of the total construction process and which underpins all activities and business of an organization involved in any of those stages. The development of formal quality management system has evolved from the need to comply with worldwide quality standards for instance, ISO 9000. Compliance with such standards implies that an organization follows documented procedures and working practices.

In the international construction scene, the inclusion of both the traditional quality and safety efforts within a TQM system is advocated by Dias and Curado (1996). They suggest that the TQM emphasis on the customer will lead to protection of the employee who is a vital customer, as mentioned previously. They write that safety record keeping, particularly in Europe, would be improved and a needed "safety culture" comparable to the existing "quality culture" would result. They suggest that an international standard for safety measurement be developed comparable to the models for quality management such as the ISO 9000 series. A research project done in collaboration with the European Construction Institute studied the state of integration of safety and quality altogether with environmental management (Coble, R.J.; The finding was that the systems generally remain independent of each other in spite of probable benefits that would accrue from closer integration. Some of the reasons for the lack of integration are perceived difficulties due to project-specific requirements, legislative requirements, and a general lack of understanding and commitment.

A study of the Hong Kong construction industry concluded that mere legislation of safety requirements had been inadequate to protect the workers (Lo 1996). It is suggested that safety would be greatly improved by including it as part of the existing ISO 9000 quality management system. ISO 9000 accreditation is required for bidding on work for the Hong Kong Housing authority and this has been a major incentive to obtain accreditation. The author contends that having safety included in the quality standard would insure that it be treated more seriously. In Hong Kong, requiring company initiated and independently audited ISO 9000 has proved to be a more effective approach than detailed safety legislation.

It is clear that quality and safety are complementary issues. They are distinct but similar. The associated problems have common roots in the laws of probability, the indifferent universe and human nature. This is why the programs devised to manage these look so much alike. The value of including safety in TQM is recognized in the United States and in Europe. Given, then, that this close relationship exists, what are some possible implications? Each of the next four sections is a proposition based on the quality/safety relationship.

2. Similarities between construction quality and safety

It should be evident that the similarities between quality and safety issues in construction are striking. The similarities are discussed as follows:

2.1 Scope: constant and pervasive

Both quality and safety relate to the successful performance of the job and pervade the entire process from design to estimating to contract negotiation and throughout the construction process. Both quality and safety require constant vigilance and effort; everyone, including subcontractors, must participate in the effort. Another similarity in scope is that while many of the results are dear at the end of a project, both quality and safety have long term implications. Quality problems and chronic health problems may be discovered years after the project is completed.

2.2 Critically to success and goal: No failures (deviations or injuries)

Efforts to maintain quality and safety focus on a common objective: minimizing disruptions to the efficient process of completing a job. In both cases the disruptions are usually the result of human errors or adverse circumstances. In quality, the disruptions are called deviations; in safety they are called accidents. In fact, an accident can be defined as a type of deviation. If the requirement of a zero injury job is established, an injury is a failure to meet the requirement and therefore, by definition, a deviation. This approach places the safety function within quality management. "Doing it right the first time" can refer to the process (safety) as well as to the product (quality). To put it another way, both quality and safety efforts combat the seemingly universal principle known as Murphy's Law: if anything can go wrong, it will.

2.3 Obstacles and problem causes: Indifferent universe, probability and human nature

The real foe may be the laws of probability and an indifferent universe. If there are ten ways to do a task and two of them lead to the correct result but eight of them lead to the wrong result, it is probable that doing the task carelessly will lead to the bad result. There are many opportunities to fail. The element of chance tempts some to gamble with both quality and safety.

2.4 Detection: immediate or delayed

Detection of failures should be early planned. Risk analysis should be conducted in which probabilities of goal failures or problems that may arise can be detected before implementation. Through this risk analysis, the management can foresee the losses that may occur due to failures and alternative solutions can be planned. A delayed detection on problems may contribute to monetary losses and delayed in work programmes.

2.5 Effect of Failure

The immediate fallout from a newly discovered major quality problem and an injury causing accident looks the same. Work stops; management becomes involved; investigation is undertaken; blame is assigned; morale is eroded; and time and money are wasted. The results of a failure in either quality or safety may be immediately apparent; however, failures in either may not be apparent for some time. The latent quality failure may lead to warranty work; the hidden safety risk may lead to delayed chronic health problems. Either a poor safety record or a poor quality record can harm a company's reputation and may disqualify the company from bidding some jobs. The nature of the disruptions caused by failures of quality and safety are often the same in which they generate additional direct costs and indirect costs. Besides, reduction on productivity and hurt morale are also results of failure.

2.6 Response: systematic program

Maintaining quality and safety represents a great challenge to managers because of the variety and complexity of the factors involved. Seemingly, problems are caused in both areas by many of the same factors. Some of the contributing factors are poor design, poor management practices, improper equipment, untrained personnel, adverse working conditions, and a host of human factors such as distractions, indifference, and substance abuse. Fortunately, many of these problems can be successfully addressed through a quality or safety program. A further challenge in connection with the program is measuring and verifying its monetary value. A non-event cannot be measured; it is possible to gather enough statistical evidence to give adequate guidance for establishing an appropriate level of effort.

2.7 Difficulty in optimizing the program

Difficulty in optimizing a scheduled and outlined program for both safety and quality is another similarity. Both concepts require major management input and constant monitoring is necessary. Back-up plans are also necessary in case the outlined program goes awry during implementation. Management team should be back-up by professionals who really practice their skills, knowledge and diligence.

Some of the major similarities between quality and safety issues are indicated in Table 1. In view of what is indicated above, it is not surprising that quality and safety programs have so much in common.

<Table 1: Construction quality and safety programme components comparison.>

3. The interaction of construction quality and safety

Although there are differences between quality and safety, as has been pointed out, they are neither mutually exclusive nor contradictory. The fact that some sort of positive relationship exists between quality and safety is recognized in TQM programs. Safety is included as one of many elements of TQM. The cover of the October, 1993, *Constructor*, AGC's management periodical, proclaimed that safety is a key to TQM. Krause (Coble, 2000) lists eight TQM continuous improvement principles that he says apply directly to safety. In addition to the continuous improvement concept, the TQM concepts of teamwork and customer focus relate to safety. The employee is a vital part of the team as well as an important customer; therefore, worker well being and satisfaction are important. Quality management says "do it right the first time"; TQM adds new emphasis to the idea that "doing it right" includes doing it safely. Thus, under TQM, safety is a quality issue. Even apart from TQM, quality management is important to safety. For example, materials testing, which is a function of quality management, may have a profound influence on safety. Determining the maturity of concrete is the job of quality management. As another example, certain kinds of double connections for steel member assembly are unsafe. These may be discovered and rejected by quality management while checking submittals. Thus, quality leads to safety (Coble, 2000).

In a very practical way, safety is also important to quality. A safe work environment which allows a worker to concentrate on the job surely increases the probability that the job will be done correctly; this is the definition of quality. At the very least, danger is an unnecessary distraction. Thus, safety leads to quality. It is difficult to think of a situation in which working safely could do anything but enhance quality. Putting it the other way, since quality is always desirable, the employee should have a safe environment to work in. It's difficult for a mason to lay brick in a straight line if one hand is needed to hang onto the scaffold. There are other ways in which quality and safety intersect. Even if management thinks of employees as mere tools of production, it is only good management to protect the means of production. It is becoming increasingly difficult to find qualified construction employees, especially in the crafts. Since quality requires well trained, well motivated workers, it is in the best interests of quality to support safety efforts merely to reduce losses of company quality assets. Not only do quality and safety support each other, they can be synergistic, actually increasing their mutual effectiveness. A good quality program by its mere presence should enhance the safety program and vice versa. A zero defects program should help with the zero accidents program. Figure 2 depicts the interaction between safety and quality.

Figure 2: Interaction of quality and safety.

4. Consolidation of safety and quality functions

The similarity of the safety and quality functions and the fact that they operate simultaneously in the same environment leads to the conclusion that it might be beneficial to combine or at least closely coordinate the management activities. Some economies of operation might result, and making safety and quality a seamless whole in the employee's experience could have a positive effect. In a sense, this is done when safety is included as an element of a TQM program, but a greater emphasis on the nature and importance of safety and quality is warranted. One approach would be to combine the programs using a workable management framework. The mission of this program would be to achieve the company construction goals in the most efficient and humane manner. This means that the goals would be achieved without any quality, safety, or efficiency related losses. A review on quality and safety concepts will be discussed before further elaboration on framework design to be adopted is proposed.

4.1 Safety management concept

In general, Safety Management is a concept that brings forth a more comprehensive approach, allowing participation and contribution of all levels of management and workforce. This management approach is developed from the conventional safety management (CSM), taking all the characteristics and actual on-site risks into consideration. In fact, it has the potential to increase competitiveness and improve productivity for an organization. Effective safety management has three main objectives, namely to (a) make the environment safe, (b) make the job safe, and (c) make workers safety conscious. The concept of Safety Management grew out of a need to transform safety and health management from a strict compliance orientation to performance orientation in which compliance is an important issue but not the only issue (Geotsch, 1998). Safety and health should be a key element in an organization's plan for gaining a competitive advantage in the global marketplace. Its purpose is to give organizations the sustainable competitive advantage of a safe and health work environment. Basically, safety management concept is similar to quality management.

The concept of Safety Management is based on a well-planned system in which the main pillar for this system is the roles and responsibilities of the consultants or participants involved within specific project. The creation of safety programs comes in a very wide scope and there is just no limitation on the strategies that can be taken to provide an efficient health and safety planning and procedures to be practiced. As construction site is the main source of fatalities and accidents in the construction industry, the concept of the safety management which stressed the importance of a well-defined organization

structure and the safety planning, eventually, this concept is seen as having the potentials on eliminating the hazard risks that normally occur on the construction site.

4.2 *Quality management concept*

Quality Management may be defined as the optimization of efforts to make sure that the requirements are met efficiently and on the first attempt. Things should be "done right" the first time and "rework" avoided. Optimization of effort implies that the most efficient level of effort is sought. This is done by minimizing the total costs of quality, a concept discussed later. Quality does not happen automatically. Even if every participant in the construction effort has the best intentions, human factors such as haste and ignorance, management decisions such as sequencing and crew composition, and "uncontrollable" events such as vendor incompetence and adverse weather necessitate the creation of a system to make sure that tasks are accomplished correctly. This is the domain of quality control. Also, the owner and sometimes the public needs assurance that the contracted product has been delivered. Providing this is often called quality assurance. The meanings of the terms "quality control" and "quality assurance" as used in the construction industry are sometimes blurred, but, however defined, they are both included in quality management. To accomplish quality assurance and/or quality control generally requires designated personnel and equipment. The preparation of a quality program, a general document, and specific quality plans, as required by some contracts, constitute one level of quality effort. The implementation of the quality plan requires specific quality activities such as materials testing, submittal checking, equipment recalibration, and general inspection of work. Employee training may also be classified as a quality activity. It is obvious that there are many specific quality related expenditures.

Quality programs are formal written systems for achieving quality. They typically include a policy statement, which states the support of top management. They also define quality-related responsibilities and include directions about such things as documentation, training, and general process control. The term "quality plan" usually refers to a job-specific application of the quality program. It will outline disciplined and detailed control and assurance activities such as vendor evaluation, plan checking, submittal reviewing, and materials testing. Some typical components of quality programs are listed in Table 7-1. In this case, the items indicated above as being in a quality plan would be under process control. Program performance refers to some method to determine if the program is successful or profitable. This might be done by measuring owner satisfaction or by financial results, as in the method described in the following section.

4.3 *Propose application model*

Project Quality Management model is used as a basis of safety management model. The Project Quality Management model conceptually is divided into 3 major elements or processes. Under each of these elements, the concept of management as theoretically defined by Walker is adopted. Basically, the model defines the process of "input - conversion process - output" as the method on achieving the achievement of management's goals and objectives. 'Input' is considered as the planning effort, the strategies or the approaches used in achieving the output whilst the 'conversion process' is the measuring and conversion process which is also known as 'tools and techniques' that should contribute to expected result. 'Output' is the result of systematic implementation or input and conversion process to make sure the program is achievable and workable. In determining the processes for integration management concept, several procedures are taken such as using similar processes as featured in quality management model and comparing and evaluating safety management key elements and making comparison with processes of quality management.

A generic application model will be discussed for this research paper. The application model concentrates on determining the processes to use. Determination is done by making comparison between safety key elements and quality management processes. Restriction to the development lies in the imposition of guidelines and regulations regarding the OSH management for construction. Evaluation and comparison between quality and safety management shows that quality and safety is based on similar approach concept, as proven by precedent studies (Coble, R.J). The Project Quality Management model consists of three components; i) planning, ii) assurance, and iii) control. As for safety management, the key elements that build the whole safety management consists of 5 areas, i) policy, ii) organizing, iii) planning and implementation, iv) measure and v) review. However, analysis done on standards at international level and what applied here in Malaysia, shows a slight difference in the number of elements used to build up the whole safety management concept. The number of elements somehow does not mean that the approach is different as the components and contents of the elements are still based on what established in international standard. This model suggested that quality management should consist of 3 key elements – quality planning, quality assurance and quality control. Under each category, the 'input-conversion process-output' takes place. Achievement of positive result (output) under each category will ensure the success of safety practice and program's implementation.

The central idea of identifying the key elements is viewed as a process which depends upon continual feedback, certainly from reviews and audits, but also during the earlier stages, so that there is a continual, dynamic system in place (Holt, A.S.J.). This model is adopted in Malaysia with some variations to suit the existing practice and the early development of safety and health program locally (Dept. of Standards Malaysia; 2003). Taking similar concept, elements

and system, the safety management model is developed using the same basis as depicts in Figure 3. The main reason on suggesting Quality Management model as basis for designing the safety management model is due to its rational development and relevancy of one element to others.

5. Conclusion

The fact that OSH is still in its early development stage in Malaysia explains only selected guidelines and acts being regulated. It may take a couple of years before a final series of guidelines covering every inch of construction works can be regulated. A more comprehensive application model deriving from a fundamental model theoretically produced can be used as guiding principle for safety management. The application model in fact is a substitute for the non-existence of compliant guidelines or requirements of construction plant and machinery. Since no other application models both for construction plant management and safety management have been produced except for those two theoretical diagrams, these models can be used as basis for the development of the application model.

Based on the findings of the study, the provided information indicates that unsatisfactory safety culture and lack of responsibility towards safety in general are what happened in the real construction field in Malaysia. There was inadequate imagination and ideas in propagating safety at work. Lack of management control leads to a lowering of performance standards; these standards may be training, communication, program, etc. According to management theory, management's functions are to plan, organize, command, coordinate and control, and all managers are expected to fulfil these functions.

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Table 1. Construction quality and safety programme components comparison.

Quality	Both Quality and Safety	Safety
Document Control	Policy/Mission Statement	Hazard Identification And Control
Vendor Selection	Organization Structure And Responsibilities	Hazardous Communication Program
Field Trials	Training	Substance Abuse Prevention
Quality Audit Procedures	Process Control / Work Rules	Emergency Procedures
	Investigations	Incentive Program
	Record Keeping	
	Program Performance	

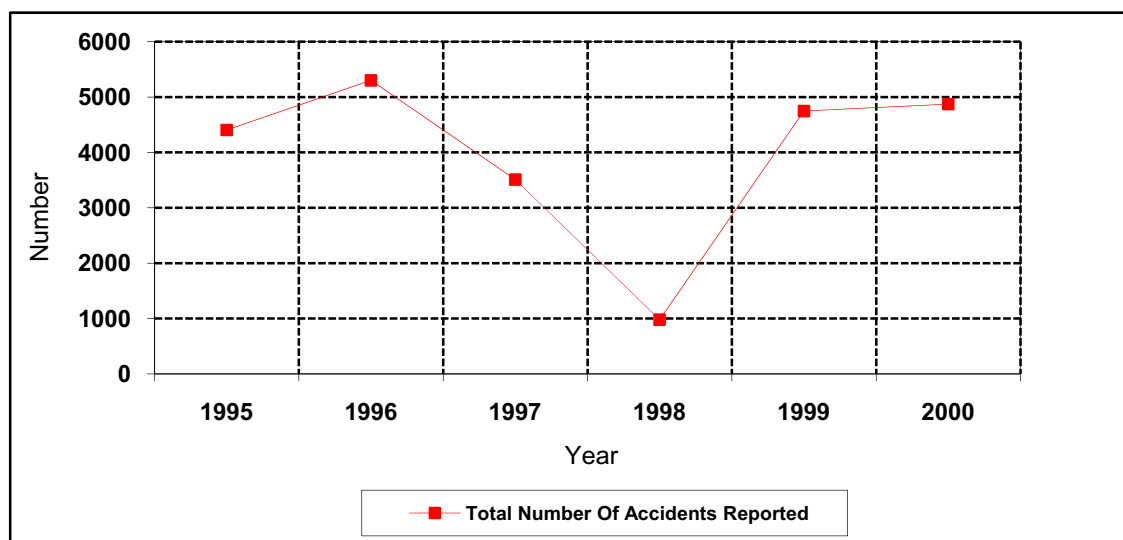


Figure 1. Reported accidents in the construction industry from year 1995-2000 (SOCISO, 2000)

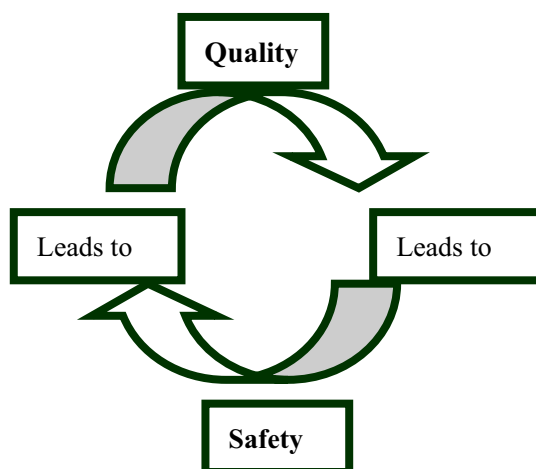


Figure 2. Relationship between safety and quality