Effectiveness of Quality Planning in Construction Projects

by

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CERTIFICATION OF APPROVAL

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Approved by,

_____

(Ir. Idris bin Othman)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK

September 2012

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

_____

NOR ATIQAH BINTI ZAINAL

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ABSTRACT

There are four measures in measuring the success of a project which includes the cost, schedule, quality of performance and safety. Each of the factors affects the outcome of the project significantly. In order to produce a high quality production, quality planning is required. Quality planning is basically a procedure in executing outcomes that ensures all customer needs are achieved and reaches customer satisfaction. The techniques and procedures of quality planning are applied using tools that help the enhancement and development of an excellent execution. The purpose of this paper is to investigate deeper on the factors that contributes to the effectiveness of quality planning, identifying the common problems encountered in quality planning, practices and ways for improvements in quality planning for construction projects. This paper involves data collected from construction company representatives across Malaysia that are obtained through semi-structured interviews as well as questionnaire distributions. According to the literature review, quality planning benefits both company and clients, where by it increases profitability, minimizes avoidable cost, increases effectiveness and competitiveness, completion on time, cost within budget and performance guaranteed. All of the resources usage can be optimized to deliver even higher profit margin without jeopardizing the quality of the end product. It benefits the construction industry to attain a better perception of project purposes, to develop good organization of the operation, eliminate or reduce improbability, and provide a basis for monitoring and controlling work.

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INTRODUCTION

1.1 BACKGROUND OF STUDY

Construction projects are complex dynamic systems that are subject to a large number of random external processes (AbouRizk,S. 2002 and Mohamed, Y. 2002). A big part of carried out activities in construction organizations deal with planning, executing, coordinating and controlling projects, for example constructing new structures (Blyth *et al.*, 2004). The most essential part in every construction work is the project planning. A contractor may have an excellent networking of suppliers, high technology equipments, plants and machineries as well as strong cash flows, however in order to be a competitive construction company nowadays, quality planning is required (Knutson, K 2008, Schexnayder, C. J. 2008 , C 2008 and Mayo, R 2008).

The concept of quality planning in construction projects is to guarantee efforts to accomplish the necessary level of quality for the outcome which are well planned and organized. It is vitally required for a construction company to have an effective quality management system as it helps organizations in improving customer satisfaction whilst providing the organization with a competitive advantage over fellow competitors within the industry (AJ Clark Group, 2012). Similarly cited by Tan and Abdul-Rahman (Tan & Abdul-Rahman, 2005), it is about obtaining customers' satisfaction that would lead to long term competitiveness and business survival for the companies by maintaining the quality of construction activities at a mandatory standard.

The term quality is defined as fitness for use (Juran, J.M. 1998). It is about achieving or going beyond customer expectations at a price that signifies a value to them (Harrington, H.J 2007). Generally, quality project planning is to produce the deliverables of the project successfully using the establishment of a set of directions in sufficient fact to inform the project team exactly what must be done, when it must be done and what resources to use in (Meredith and Mantel, 2006)

Planning is a challenging and basic activity in the administration and carrying out of construction projects. It involves the estimation of the necessary resources, the description of work duties, durations for individual tasks, the selection of technology and the identification of any connections among the different work tasks. (Hendrickson, C 1998). In order to produce a quality planned project, proper planning techniques are required. Using the right techniques in planning, it helps in the analysis of the plan, organizes the information and gives a crucial effect on the way in which the plan is communicated (Neale, R. H. 1989 and Neale, D. E. 1989). Therefore, I strongly believe that this research could prove beneficial in many ways to the construction industry.

1.2 PROBLEM STATEMENT

As observed throughout the years, the achievement of adequate levels of quality in the construction industry has been a setback due to nonexistent and poor quality of planning practices, a lot of the construction projects do not achieve their targets (Brown *et al.,* 2001; World Bank, 1996) where by major outflows of time, money and resources, both human and material, are wasted each year. Based on a survey done by World Bank (World Bank, 1996), out of 900 construction projects, on large-scale, approximately 40% of the projects were over budget and 60% of them were completed in an overrun time. Even in successful construction projects, cost and schedule overruns occurred (Leung *et al.,* 2004). None of the negative outcomes mentioned would have occurred if the planning ahead of time was developed well for quality techniques and proper control methods to produce quality outcomes.

As a result, the need for improvement in project success in the construction industry is the main motivation for this paper. This study focuses particularly on the quality planning stage of a project, due to its high magnitude in determining project success (Kerzner, 2006; Zwikael *et al*., 2005; Turner, 1999).

1.3 AIM AND OBJECTIVES

The objectives of the research are to:

- Identify factors that contribute to the effectiveness of quality planning in construction project.
- Investigate problems that are encountered in quality planning for construction project and determine the improvements that can be implemented for quality planning in construction project.

1.4 SCOPE OF WORK

The study will be focus on quality planning in construction projects in Malaysia. The aim is to identify the problems that occur in current construction projects, explain the various methods of quality planning and its effects on the project performance. This research does specify from the Project Manager's point of view. Limitation of this study is based on the fact that the responsibility for planning lies entirely with the project manager, who must ensure that the project is carried out properly and to the complete satisfaction of customers. In some projects, a quality management team is hired to do the job, however following up to the majority projects, the project manager usually holds the main task of planning the project to produce excellent execution.

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CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Quality is the characteristic element of an item that can be evaluated as a meeting standard, where by if it meets or exceeds the standard, it can be said to be of good quality or high quality. However if the item does not meet the standard, it is considered poor quality (Mincks, W. R.1997 and Johnston, H. 1997). Quality Planning is about identifying which standard is relevant to the project and determining how to satisfy them (Visaya, M. 2011).

2.2 THE PRINCIPLES OF QUALITY MANAGEMENT SYSTEMS (QMS)

QMS is the interaction of people, processes and documentation to meet both customers' stated and implied needs (Mohammed, A. H. 2006 and Abdullah, M. N. 2006).

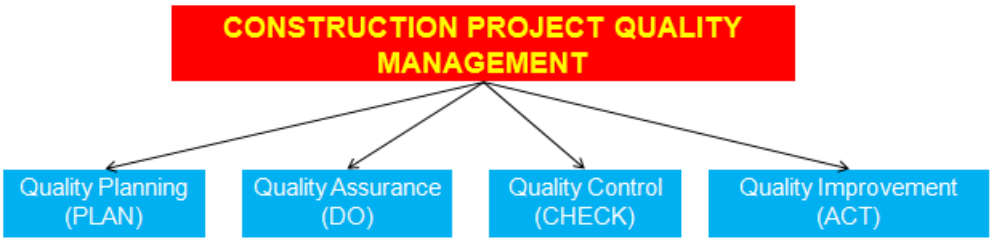

Figure 2.1 Approaches to conformance in Quality Management

Based on the figure above, there are four basic approaches identified in Quality Management, which are the quality planning, quality control, quality assurance and quality improvement (Visaya, M. 2011). Quality Planning is basically one of the steps

in Quality Management. In order to proceed with the do, check and act, it is essential to quality plan the process ahead of time to produce quality outcome. Listed below are the other key aspects of Quality.

i) Quality Engineering

Procedure description on how to assure that design for a structure and engineering goes as recommended and the necessary criteria set by trade associations and related professionals, building code authorities, and federal, state, and local organizations and others. The law and certain requires most of the standards and are revised frequently which makes it essential for the engineers and architects to be knowledgeable and updated on all applicable standards (Barrie, D. S. 1992 and Paulson, B. C. 1992).

ii) Quality Assurance

Quality Assurance is defined as a systematic activity to develop a formal structure, organization and operational procedures to ensure specified quality throughout the project life cycle (Napiah, M. 2012). Due to the risk engaged in any project, quality assurance is significant in the construction industry and engineering. A lot of external factors will influence the performance of the project causing the risk involved in not completing the project on time becomes high. It is vital that a built-in quality assurance system is developed to keep away from any inefficiency that could result in poor quality of products and service being delivered to the customers (Bubshai, A. A. 1999 and Al-Atiq, T. H. 1999).

The key factors for Quality Assurance includes define in writing authority and responsibility for each personnel, define and standardize each activity of the work and maintain records of each activity (Napiah, M. 2012). From the Arkema Inc. facility's

(Arkema Inc. Facility, 2011) view of the position responsibilities in common construction projects, the construction contractor will be responsible for compliance with the construction documents, drawings, and specifications as well as for the quality of construction in the finished outcome. The Project Engineer will have crucial responsibility for the oversight of construction and for conformance with the construction drawings, specifications, and quality assurance requirements.

iii) Quality Control

Quality control is the activity and practice, which are necessary for the project to maintain its specified quality requirements (Napiah, M. 2012). According to Donald and Boyd (Barrie, D. S. 1992 and Paulson, B. C. 1992), this process includes setting specific standards for construction performance, usually through the plans and specification. Variances are then measured from the standards. Actions are taken as correction or to reduce unpleasant variances and lastly plan for improvements in the standards themselves and in conformance with the standards. In other words, quality control ensures that the physical work conforms to those standards.

A company-wide attempt to improve quality of its products or services, which covers all the company's activities including market survey, R&D, design, production, inspection, after-service, human resources, training of employees and so on is called Total Quality Control (TQC). Total quality control focuses on examining the processes in an operation, to learn where mistakes are being made, why they are happening and if it is possible, practical and economically desirable to prevent them from recurring (Deming, W. E. 1986).

From the Arkema Inc. facility's (Arkema Inc. Facility, 2011) view of the position responsibilities in common construction projects, construction contractor hires the

Construction Quality Control team members. Therefore, particular positions, and their allied descriptions and responsibilities, will be set forth by the contractor procured. However, the construction contract documents require that the contractor assign an individual to manage the Construction Quality Control team and that the individual will not be directly involved in supervising construction activities.

2.2.1 Project Quality Plan (PQP)

PQP is proposed to ensure the success of quality program at project level as it is originated from ISO 9000 standards and a project-based QMS document. Therefore, the concept of PQP is crucially in need to be understood and valued as a system rather then a segment of a system.

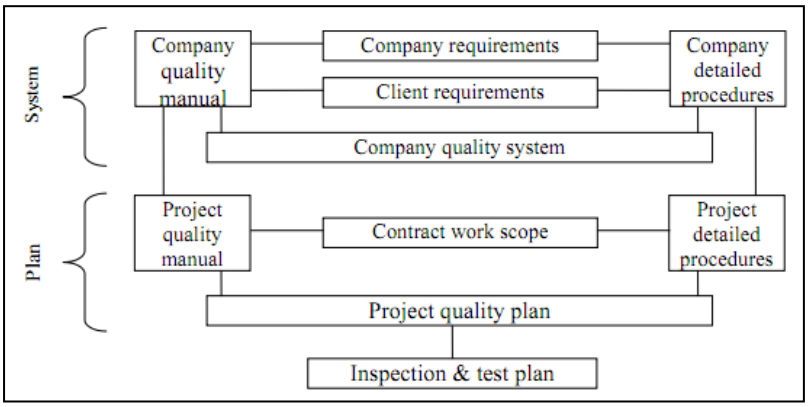

Figure 2.2 Organisation Quality System and Plan (Source: Stebbing, 1993)

The overall concept of a quality management in an organization is shown above (Stebbing, 1993). As shown in Figure 2.2, Stebbing (1993) separated the QMS into two, the company quality system and PQP. Company quality system consists of company quality manual and steps that are developed based on the company and client's requirements. In order to develop the PQP, a similar method is copied but the project quality manual and procedures are established based on the company manual

and procedures and as well as the contract work scope, however will contain additional documentation and procedures relating to that specific project (Stebbing, 1993).

Therefore it is essential for the quality manual to be understood in order to develop the PQP as it explains procedure and how an organization meets the necessities of ISO 9000 through the quality system in place, and provides a cross reference to other parts of the system (Ashton and Jackson, 1995).

2.3 PRACTICES IN QUALITY PLANNING

2.3.1 Plan Quality

According to Anamul Huq, a project manager from Bangladesh (Huq, A. 2011), quality planning should be performed in parallel with other planning efforts such as cost, schedule, procurement and risk. Changes in quality planning may definitely affect cost, schedule and risk, therefore project planners must always be aware.

Plan Quality		
Inputs	**Tools**	**Outputs**
1. Scope baseline 2. Stakeholder register 3. Cost performance baseline 4. Schedule baseline 5. Risk register 6. Enterprise environmental factors 7. Organizational process assets	1. Cost-benefit analysis 2. Cost of quality 3. Control charts 4. Benchmarking 5. Design of experiments 6. Statistical sampling 7. Flowcharting 8. Proprietary quality management methodologies 9. Additional quality planning tools	1. Quality management plan 2. Quality metrics 3. Quality checklists 4. Process improvement plan 5. Project document updates

Table 2.1 Inputs, Tools and Outputs of Plan Quality

Figure 2.3 Key Inputs for Plan Quality (Huq, A. 2011)

Figure above shows the seven key inputs for Plan Quality obtained from Anamul Huq's writing. He (Huq, A. 2011) also further elaborated on the tools required in a Quality Plan. As listed in the table 2.1, the tools are as follows,

i) **Cost-Benefit Analysis** refers to the cost of connecting in quality management activities against the produced benefits to the project, and usually used for quality planning purposes. The potential benefits of meeting quality requirements includes higher productivity, less rework, increased stakeholder satisfaction and lower costs.

ii) **Cost of Quality (COQ)** is the total cost of attempts to achieve quality, which includes the costs of conformance and non-conformance. Prevention, appraisal, and failure are three particular categories of costs as shown in Table 2.2 below. Preventing defects is favored over costs of non-conformance and is believed to decrease overall costs.

Prevention (Build a Quality Product) "Conformance"	Appraisal (Assess Quality) "Conformance"	Failure "Nonconformance"
• Planning • Training • Equipment(calibration and maintenance) • Audits	• Audits • Test and evaluation • Process control • Inspection	**Internal (found by project)** • Scrap • Rework **External (found by customer)** • Liabilities(recalls) • Warranty work • Lost business

Table 2.2 Categories of Costs

iii) **Control Charts** are used to find out whether a method is stable to produce predictable results. Control limits identify points at which corrective action is considered, requirement limits are necessities in the contract, and planned goal, three major types of data that the charts track.

iv) **Benchmarking** is basically comparing actual project practices or planned to those of other projects to produce ideas for enhancement and provide a standard to measure Performance against.

v) **Statistical sampling** is choosing part of a population for inspection.

vi) **Flowcharting** are diagrams used to assist in investigating on how problems occur, decision points. Most flowcharts show activities and the sequence

in which procedure steps take place. These diagrams help improve processes and help anticipate where problems might occur.

vii) **Proprietary Quality Management Methodologies** includes methods such as Capability Maturity Model integrated, six sigma and quality Function Deployment.

viii) **Design of Experiments (DOE) is a** statistical practice that assists in investigating how different variables influence project outcomes.

ix) **Additional Quality Planning Tools** that can assist in signifying quality obligations includes brainstorming, affinity diagram, force field analysis, nominal group technique, matrix diagrams and prioritization matrices.

Figure 2.4 below shows the five key outputs for Plan Quality obtained from Anamul Huq's writing on Quality Planning which involves Quality Metrics, Quality Check, Quality Management Plan, Project Document updates and Process Improvement Plans.

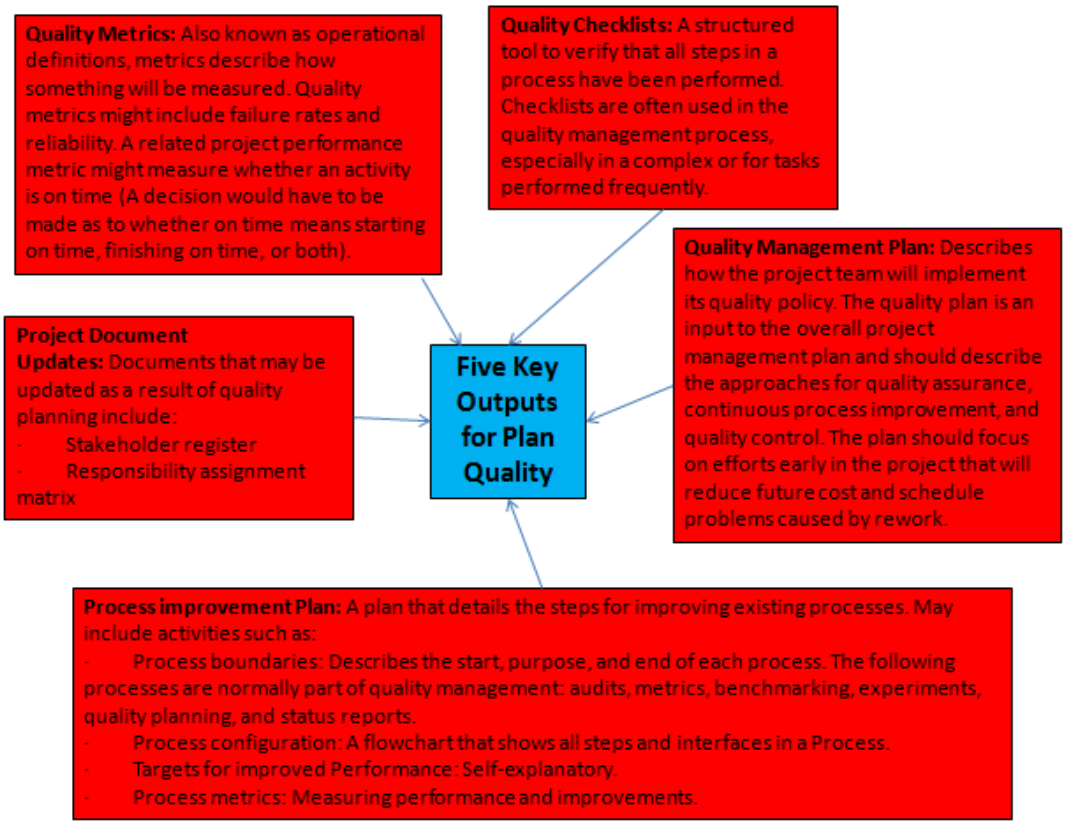

Figure 2.4 Key Output for Plan Quality (Huq, A. 2011)

2.3.2 ISO 9000 Series Standard

ISO 9000 is an international standard intended to provide the generic core of a quality system standard applicable to a broad range of industries and economic sectors. It outlines how a supplier can establish an effective quality system that will demonstrate commitment to quality and ability to meet customer requirements (Bubshai, A. A. 1999 and Al-Atiq, T. H. 1999).

The concept of ISO 9000 has been viewed in various ways, as a means of enhancing the overall quality of projects, as a required response to competition, as a way to

decrease cost, as a means to improve the flow of activities and coordination in the organization, as a strategy to have better sales through an improved quality image, as a way to maintain competitive edge in the industry, etc. (Bhuian and Al-Zamil 1996; Lamprecht 1992) Many of them are already registered with the certification bodies to develop formal quality management systems and to seek certification to the ISO 9000 quality standards. (Pheng 1998).

ISO certification is a trend in the majority industries at the present time including construction industry. The ISO 9001 standard is now on its year 2000 revision. The five clauses for its execution are quality management system, management responsibility, resource management, product realization, and measurement, analysis, and improvement. The application of ISO standards has received much attention from researchers (Tan, C. K. 2011 and Hamzah, A. R. 2011).

BSEN 9000 (BSEN 9000, 2005) state that there are eight quality management values, associated with the ISO 9000 quality management system, which have been recognised that can be utilised within any management team which will allow the organisation to work towards improved performance, these are:

- Focus on Customer Relations
- Management and Leadership
- People Participation
- Process Approach
- Systematic Method to Management
- Provides Persistent Development
- Decision making based on Factual Methodology
- Equally Beneficial Contractor Associations

ISO 9000 Quality System Features

- It features a well-documented system of procedures and instructions on quality assurance, appointment of a quality manager in the company, who is responsible for quality, adequate packaging for delivery, records of all inspections and audits, segregation of rejected products like materials and documents as well as an adequate training of all staff (Napiah, M. 2012)

ISO 9000 Quality System Requirements (Napiah, M. 2012)

- In terms of Engineering, the requirements include holding the key engineering meetings and maintain records of meetings as well as maintaining engineering revision sheets (ERIs).

- For the documents part, includes the need to maintain document approval procedures, record issuance or receipt of all transmittals and documents, maintain and control ERIs and maintain latest issues of applicable law and regulations.

- Disposition of Nonconformity includes action and report on each nonconformity, issue nonconformance reports and feedback data sheets

- Corrective Action to maintain control sheets on request, execution and review on corrective actions

- Training qualification, record for each personnel and training in each project organization.

2.4 PROBLEMS ENCOUNTERED IN QUALITY PLANNING

Certain problems have been observed in relation to quality planning implementation.

1. **Management Mistakes in Proposal**

In certain cases, the bidding made was too low or too high due to incorrect estimation, in other words, estimation error occurred. There are a few possibilities why estimation errors could occur, it may be due to wrong estimation method or could also be because of the insufficient in-house cost data. In other cases, the contractor bid on a bid was not supposed to be made.

2. **Design Mistakes**

Calculation mistakes often occur due to carelessness, inexperienced and lack of knowledge regarding designs and material selection. Not enough analysis on design, as well as not knowing the proper short-cut of designs is also common mistakes.

3. **Procurement Mistakes**

The common mistakes relating to procurement are error in specifications, vendor's design mistakes, vendor's fabrication problems and faults found at inspection and test.

4. **Logistics Problems**

Packing and storing not properly done, damages during transportation, difficulty in customs clearance and difficulty and problems encountered during transportation.

5. **Construction Quality Problems**

In producing quality structures, it is important to ensure that the material selection is studied and assured to be suitable for the project design. The common quality problems of construction projects usually relates to the quality of soil, improper concrete foundations, tolerances, material identification, welding rod mistakes, short-cuts in construction and design errors.

6. **Accidents incl. Explosion and Fire**

The safety issue has become very essential, due to the number of accident cases occurring that has been increasing rapidly. There are a lot of different types of accident that usually occur during construction projects, such as accidents caused by design faults, accidents caused by miss-operation, accidents caused by construction faults, fire caused by loose safety procedures and insufficient fire safety.

7. **Performance Problems**

Performance problems are often related to the projects not meeting product specifications, not meeting capacity requirements, mechanical problems, electrical problems, instrumental problems and miss-operation.

8. **Lack of communication**

(Kubal, 1996) argued that the construction industry is lacking open communications and mutual support that derived from trust-based relationships among project participants to effect substantive quality improvement.

2.5 IMPROVEMENTS IN QUALITY PLANNING

Based on the problems listed, there are a few methods in improving quality planning that can be done to enhance the quality of the project outcome.

iv) Total Quality Management (TQM)

Total quality management (TQM) is often defined as a complete management philosophy that seeps into every aspect of a company and place quality as a strategic issue. An integrated effort between all levels of a company is how it is achieved, to increase customers' satisfaction by continuously improving current performance (Biggar, 1990).

The adoption of TQM in construction industry has been promoted in some literatures (Low & Teo, 2004; Biggar, 1990; Haupt & Whiteman, 2004). (McCabe, 1998) highlights that in order to achieve TQM within any organization it is vital that the following aspects are considered. Firstly, the environment should encourage teamwork, communication and cooperation. Secondly, in order to create these conditions known as the organizational structure, will require an analysis of the current situation which will allow a starting point to be identified for any amendments which are necessary.

Followed by, if cultural change is required within the organization it needs to be assisted by key personnel. Lastly, there are two ways of managing change which are working from the bottom up in management is more likely than working from the top down.

v) The Six Sigma

The Six Sigma concept offers a method to detect key problems and defects in all procedures involved in the project, measure defects and quality, creating room for improvement, and analyzing products to meet quality standards (Six Sigma Training Assistant, 2011).Six Sigma improves quality by improving customer satisfaction, reducing defects, reducing response time between players, and managing labor and resources.

vi) Define, measure, analysis, improvement and control (DMAIC)

Define, measure, analysis, improvement and control (DMAIC) that manages on the standard of documenting the scope, budget, goal time duration and possible problems and solutions of the project and uses all for reference during the stage of the project production procedure (Six Sigma Training Assistant, 2011).

vii) ISO 9000 Series Standards

According to Applied Quality Strategies (2012), implementation of ISO-9000 helps in improvement. All work orders are documented and thus helps eliminate variation within the process leading to efficiency improvement. The cost of quality is reduced with efficiency improvements. Employee morale is increased as they are asked to take control of their processes and document their work processes. Customer satisfaction, and more essentially customer loyalty, develops. Decreased problems resulting from increased employee participation, involvement, awareness and systematic employee training. Better products obtained from continuous improvement processes. Improves communication both externally and internally which improves quality,

efficiency, on time delivery and customer or supplier relations. Fosters the understanding that quality, in and of itself, is not limited to a quality department but is everyone's responsibility.

viii) Continuous Quality Improvement (CQI)

Based on Mosby's Medical Dictionary, 2009, CQI is a system that seeks to improve the provision of services with an emphasis on future results. Like total quality management, CQI uses a set of statistical tools to understand subsystems and uncover problems, but its emphasis is on maintaining quality in the future, not just controlling a process. Once a process that needs improvement is identified, a team of knowledgeable individuals is gathered to research and document each step of that process. Once specific expectations and the means to measure them have been established, implementation aims at preventing future failures and involves the setting of goals, education, and the measurement of results. If necessary, the plan may be revised on the basis of the results, so that the improvement is ongoing.

CHAPTER 3

METHODOLOGY

A number of methods and procedure should be taken into deliberation to reassure the intended objectives of project will be accomplished. All the data attained will be analyzed and gathered to obtain the expected end result. To sustain the success of this study, the work phase is planned in detail. The methodology of this study can be divided into three stages:

3.1 LITERATURE REVIEW

This is the early stage of research to get the overall overview of the proposed topic. At this stage research will be implemented only by documentation research such as books, journals, conference texts, agencies bulletin, project papers, internet etc. This stage is very important in order to find out the related matters that will help to cover the scope of research.

3.2 DATA COLLECTION

To achieve the objectives of the project, this stage is the most crucial part where the main data should be collected. It requires semi-structure interviews, research, questionnaires to collect relevant data information. Questionnaires will be gathered as the primary data. It will be drafted and given to those who are involved in construction projects.

3.2.1 Survey Questionnaire

The standard survey questionnaire is distributed to selected construction companies in Malaysia to achieve the objective of the research. List of construction companies selected are generally construction companies for building works, involve also in infrastructure works actively at the moment. The questionnaire will be distributed to around 50 candidates. However the data are analyzed only based on the best responds of 25 candidates.

The candidates consist of construction project participants such as project managers, contractors, consultants, owners and etc, as the process of planning involves all parties. To avoid similar responds from the candidates, the questionnaires will be given to candidates with different job scopes in one company. In the questionnaire they will be required to rate the important aspect in quality planning and it's effectiveness in projects.

The questionnaire consists of three sections in order to fulfill the aim and objectives of this study. Section A consists mainly as general information about the companies and their ongoing projects. Section B will be focused on the important aspect in quality planning. For the last section it will cover problems in projects and effectiveness of implementing quality planning. This survey questionnaire is conducted by online survey application as well as direct hand outs to the fellow candidates.

3.2.2 Semi-Structure Interview

This study implemented in-depth semi-structured interviews which were conducted with representatives from construction companies. It is believed that questionnaire survey could cover an extensive range of the study in achieving both objectives, however for a deeper and more detailed quality of information could be obtained with interview as the methodology instrument.

This approach is said to be suited to the aims of this study which is concerned primarily with discovering the experiences and opinions of practitioners in the industry (Moatazed-Keivani et al., 1999). As for that, semi structure interview was conducted as well. Before each interview session is conducted, the company is briefed about the nature and purpose of the study, to ensure that the organizations assign the most appropriate representative to be interviewed. Since construction project participants are usually busy and sometimes not able to make time for interviews, not more than 5 candidates will be selected. The example detail profiles of respondents are as illustrated in Table 3.1.

Profiles of Respondents

Respondent	Position	Years of experience
1	Project manager	10
2	Project manager	18
3	Project director	20
4	Executive director	12
5	Project manager	11
6	Quality system manager	11
7	Management systems manager	12
8	Project coordinator	8
9	Assistant general manager	15
10	Project engineer	4
11	Project manager	15
12	Project manager	9

Table 3.1 Example of Detail Profiles of Respondents

This interview aim is to determine the effectiveness of Quality Planning in construction projects in detailed as it is easier to capture the opinions of different parties involved in construction projects directly, instead of obtaining just short

answers from survey questionnaires. A semi-structured interview is flexible, allowing new questions to be brought up during the interview as a result of what the interviewee says.

3.3 DATA ANALYSIS

From the literature review, survey questionnaire and interviews, all data collected will be analyzed. The Average Index Formula method (McCaffer, M. 1997) is used to analyze for survey questionnaire data. This methodology will include charts, tables, and textual write-ups of data. These methods are proposed to process and distill the data so that readers can assemble interesting information without needing to sort through all of the data on their own.

3.4 RESULT

All the result obtained from all source of respondents, will then be concluded by the author. Next, the data will be analyzed as the findings and recommendations will be made based on the analysis of the data.

3.5 LIMITATION OF STUDY

In every study, there will always be limitations that cannot be prevented. Usually, the problem starts in the process of data collection. In certain companies, they refuse to give cooperation in providing information regarding the topic as it is said to be private and confidential information for them. It is common for companies to not reveal such information. Besides that, data from the interviews conducted cannot really be used

without verification as evidence of the information as it may have been edited or came from an untrue resource. Rectify process is required to overcome this problem.

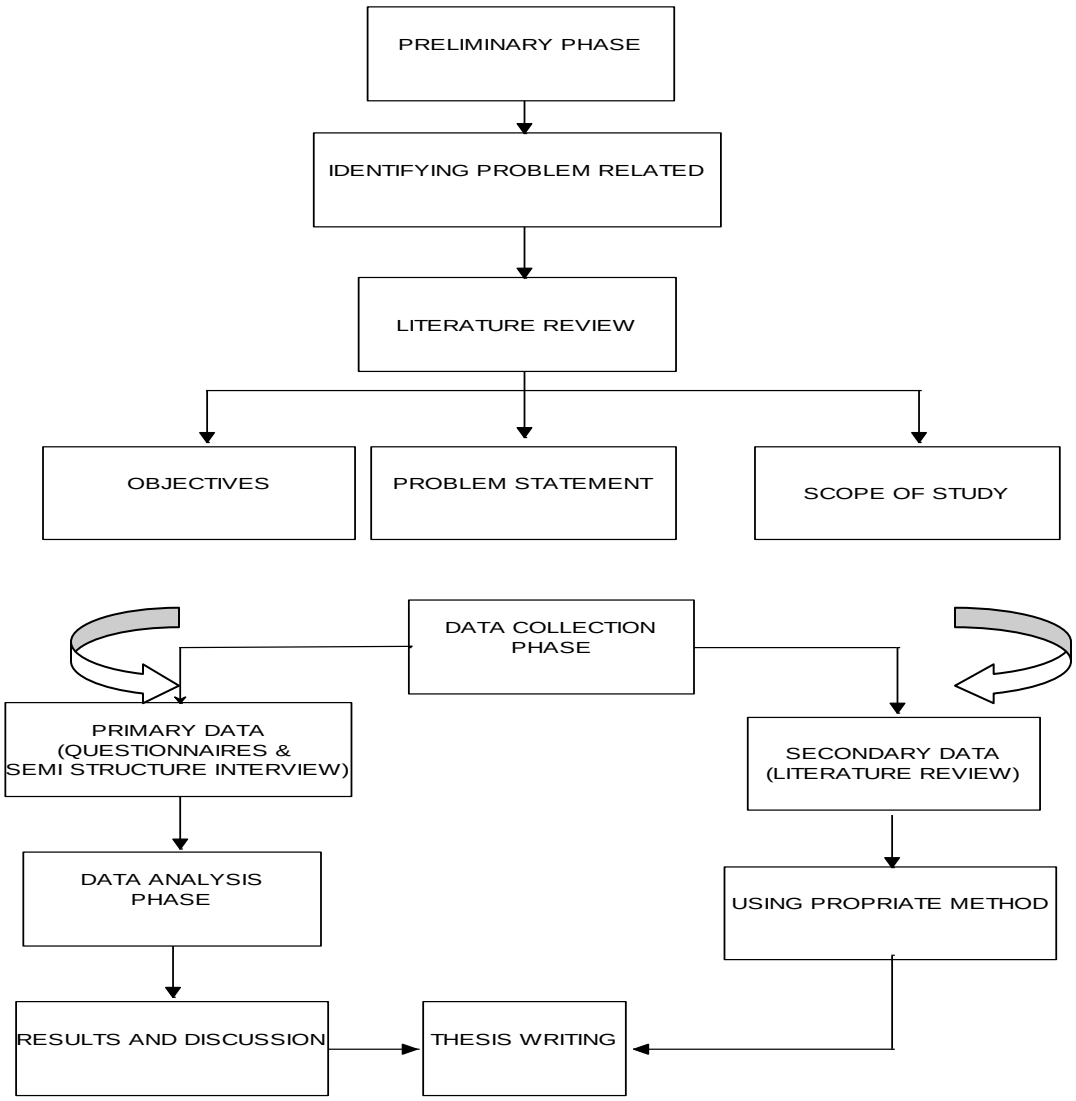

Figure 3.1: Research Methodology Flow Chart

Detail/Week	1	2	3	4	5	6	7		8	9	10	11	12	13	14
Selection of Project Type															
								M							
Preliminary Research Work								I							
								D							
Submission of Extended Proposal Defense								S							
								E							
Proposal Defense								M							
Project work continues								B							
								R							
Submission of Intern Draft Report								E							
								A							
Submission of Interim Report								K							

Process

Suggested milestone

CHAPTER 4
RESULT AND DISCUSSION

4.1 OVERVIEW

The data collected from the respondents formed the basis for the analysis of the study. The two objectives of the study, investigate problems in quality planning and determine solution to improve quality planning were to be analyzed based on the data collected from the interviews.

In the preliminary analysis of the questionnaire data, it was found that some of the respondents did not have the full knowledge of all the questions. This can be attributed to the knowledge of quality planning in Malaysia. Thus some of the questions were left unanswered in the interview. Therefore, the analysis and findings for each measure were based on the number of responses for that particular question.

4.2 PROFILE OF RESPONDENTS

The first section in the questionnaire contained the respondent profile. The information to be provided by the respondents consisted of:

1. Respondent's designation
2. Respondent's experience in construction
3. Areas of experience in quality planning
4. The location of respondent's company

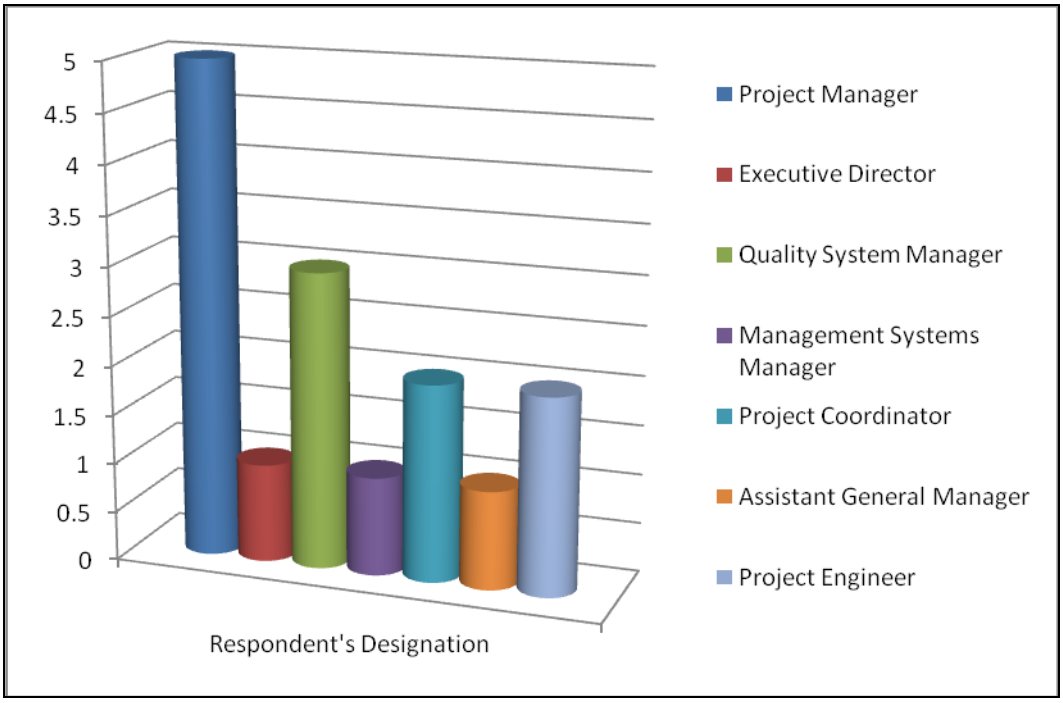

Figure 4.1 Respondent Designation

Figure 4.1 shows the respondent's designation which consist of project manager, executive director, quality system manager, management systems manager, project coordinator, assistant general manager and project engineer. Respondent's designation category is much important in this research as it adds validity to set opinions and ideas of respondents on problems in quality planning in construction project in Malaysia. Project managers have the highest proportion (33.3%) and lowest are Executive Director, Management Systems Manager and Assistant General Manager (6.67%).

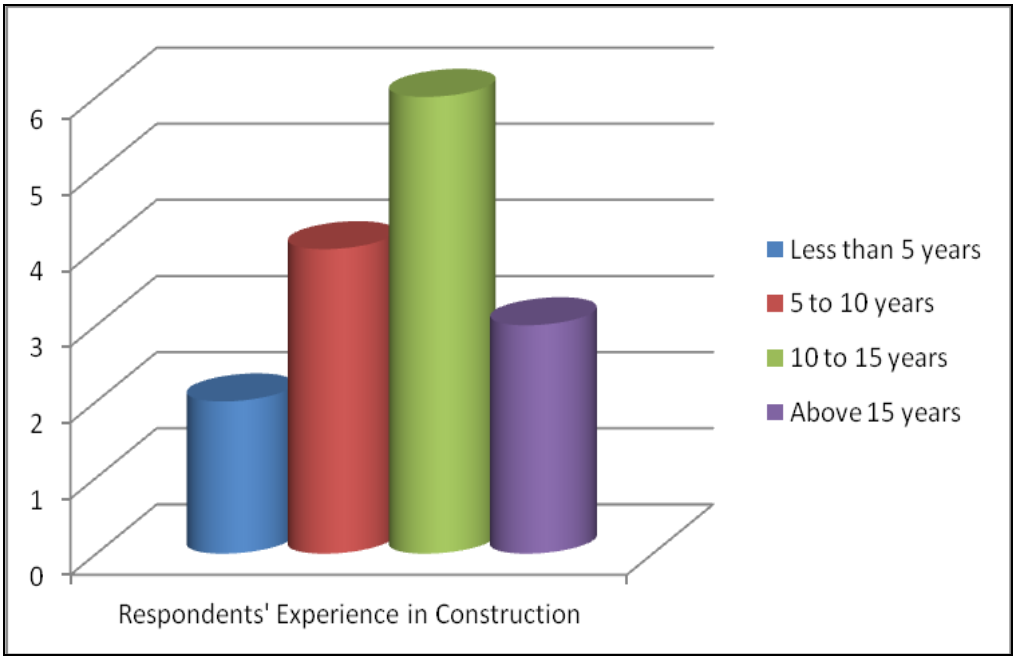

Figure 4.2 Respondent's experience in construction

Figure 4.2 demonstrate the respondent's experience in construct project. Only 13.3% of respondents have less than 5 years experience. 26.7% have 5 to 10 years experience, 40% have 10 to 15 years experience while above 15 years of experience is 20%. This adds the validity to the responses obtained because the more the years of working experience the more accurate the responses would be because of exposure in material management during working

.

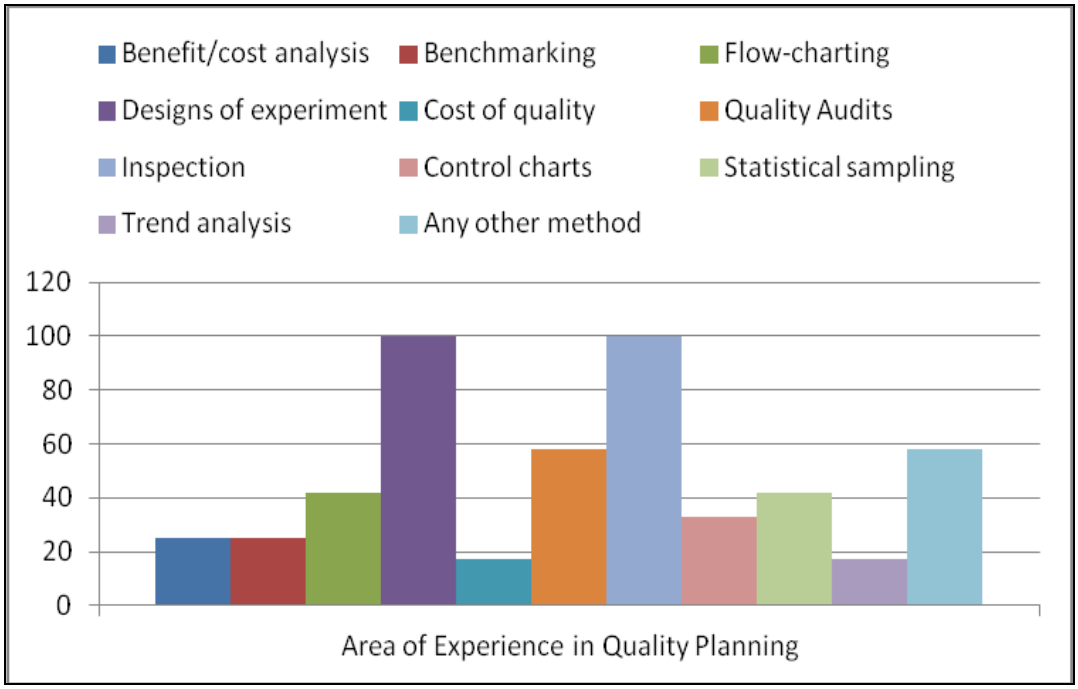

Figure 4.3 Area of experience in Quality Planning

Figure 4.3 illustrates the area of experience in quality planning for respondent. Having been allowed to identify the perspective with one or more quality planning functions, the respondents showed a relatively uniform representation of the functions in quality plans, with design of experiment and inspection as highest areas of experience. Quality audit and other methods as the second most common areas of expertise among the respondents.

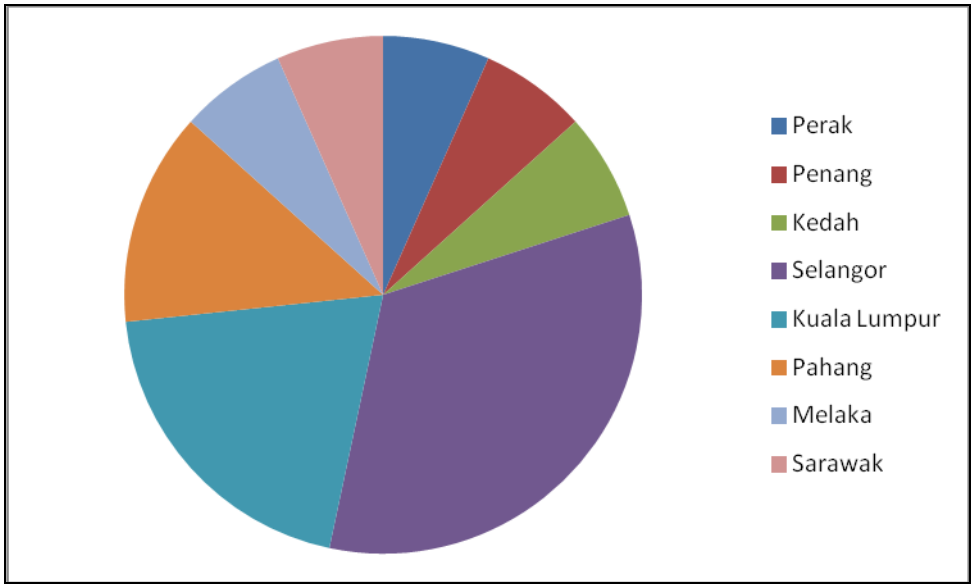

Figure 4.4 Location of respondent's company

Figure 4.4, presents the location of respondent's company. From the figure, it could be seen that the respondents are from both peninsular and east Malaysia. This adds the validity of the responses obtained. Respondent from Selangor have the highest proportion (33.3%) followed by Kuala Lumpur (20%) and Pahang (13.3%) while Sarawak, Perak, Penang, Kedah and Melaka have least proportion of respondents with 6.7% each.

4.3 IMPORTANT ASPECTS IN QUALITY PLANNING

Table 4.1 shows the ranking for each of the aspect included in the questionnaire. The aspect ranking is analyzed by using Average Index Formula method.*(Appendix B)*

Rank	Important Aspects	Average Index
1	Benefit/cost analysis	4.01
2	Benchmarking	4.13
3	Flowcharting	4.1
4	Design of Experiments	4.61
5	Cost of Quality	4.1
6	Quality Audits	4.26
7	Inspection	4.45
8	Control Charts	4.24
9	Pareto Diagram	4.1
10	Statistical Sampling	4.24
11	Trend Analysis	4.09
12	Any Other Methods	4.3

Table 4.1 Important Aspect in Quality Planning

Two of important aspects in quality planning are strongly agreed by respondents. It could be seen that design of experiments (average index : 4.61), inspection (average index : 4.45) and quality audit as well as other methods (average index : 4.26) rank first, second and third most important aspect respectively. It is expected that design of experiments (DOE) ranks first because it is an essential method in quality planning. DOE is the design of any information-gathering exercises where variation is present, whether under the full control of the experimenter or not. It should be simultaneous with the project objectives and goals to have an effective integration with the project. If DOE is not carried out properly, it can create problems during the execution of the project.

Inspection which is the next most important aspect from the ranking is so significant in quality planning because inspection is one of the most important elements in achieving a successful construction project. Proper inspection requires sound judgment, diplomacy, procedural knowledge, effective inspection techniques, and complete and accurate documentation. Quality audit is also another important aspect in the quality planning because it affects the project flow and systems in different ways. Quality audit is basically the process of systematic examination of a quality system carried out by an internal or external quality auditor or an audit team. It is an important part of organization's quality management system and is a key element in the ISO quality system standard, ISO 9001.

However, the least important aspect from the ranking are pareto diagram (average index: 4.03), Cost of Quality (average index : 4.06) and Trend Analysis (average index : 4.09). Probably, pareto diagram is insignificant to them for some reason. One of the reason might be because it is a type of chart that contains both bars and a line graph

which is not accurate enough to contribute in quality planning. Inaccuracy can result in decrease in chances of achieving a quality project execution. Cost of quality is among the bottom ranked aspect as it is the general perception, that higher quality requires higher costs, either by buying better materials or machines or by hiring more labor where by in current projects, the cost are basically limited and fully dependant on the country's economy causing the priority of extra expenditures to be less prioritized. Trend analysis is rank as number 10 because most of the companies prefer their own personal methods and project flow, rather than analyze trends of other projects.

4.4 PROBLEMS IN QUALITY PLANNING

Researchers and practitioners have studied the quality planning methods and tried to improve it with time. Many studies have been done in the past to improve the usual quality planning techniques. Studies have been done on problems existing in quality planning techniques to increase its efficiency.

Using same method like important aspect in quality planning, the result is shows as below

Rank	Problems in quality planning	Average Index
1	Lack of communication	4.42
2	Performance Problems	4.29
3	Accidents incl. Explosion and Fire	4.26
4	Construction Quality Problems	4.22
5	Logistics Problems	4.13
6	Procurement Mistakes	4.1
7	Design Mistakes	4.09
8	Management Mistakes in Proposal	3.74

Table 4.2 Problem in Quality Planning

It shows that most of the respondents agree with problem listed and classified the problems is actual problems they face in construction project. The first 3 ranks are Lack of communication (average index : 4.42), Performance Problems (average index : 4.29) and Accidents incl. Explosion and Fire (average index : 4.26). It is not surprise that lack of communication, is rank as no. 1 because this problem is a very common aspect. The respondents answered the questionnaire parallel to the previous section. The author can conclude that most of respondents have much knowledge in quality planning. This problem is major problem because it affects all other activities if preventive measure not to be taken. Performance Problems is also highest problem selected by respondents. It is because of project will fail to produce execution that achieves the requirements and specifications as supposedly achieved. The problem starts from the projects not meeting product specifications, not meeting capacity requirements, mechanical problems, electrical problems, instrumental problems and miss-operation. Other significant problem is Accidents incl. Explosion and Fire. It will lead a lot of problem such as accidents caused by design faults, accidents caused by miss-operation, accidents caused by construction faults, fire caused by loose safety procedures and insufficient fire safety.

While the bottom three of the ranking are Management Mistakes in Proposal (average index: 3.39) high number of Design Mistakes (average index: 3.48) and Procurement Mistakes (average index: 3.74).

4.5 IMPROVEMENT IN QUALITY PLANNING

In the study, data were collected by semi-structured interviews with five key people from different companies that had knowledge of construction quality planning in construction projects. There are two ISO 9001 certified companies out of the five companies interviewed. Two out of three non-ISO certified companies are currently working towards getting certified. These people consisted of three project managers, a quality assurance manager and a general manager from private organizations. The study was focused on identifying factors that contribute to the effectiveness of high-quality planning construction projects, to analyze the problems encountered in planning for the construction of quality and identify improvements implemented for planning the construction quality of the project.

Most respondents stated ISO certified company has systematic guidelines for the implementation of quality planning, however, it is interesting to note that majority agreed that the goal of marketing is the main consideration for the acquisition of ISO certification. In regards Total Quality Management, is not a current practice for any of the companies. The companies without ISO certification claimed that they practice quality management by their own approaches.

Four out of five of the interview respondents pointed out that the main measure of quality performance in the construction industry was a contractor's standing in the industry or the fulfillment conveyed by customers. One other respondent explained that getting continued business or work for clients was a evaluation for quality performance.

After analyzing the overall answers from the interview respondents, the two main questions were answered as below. The data inserted, basically is the combination of all five respondents' point of view on the subject matter.

Obstacles faced in Quality Planning	Worker attitude Lack of skilled workers Product problems Turnover in company Lack of proper equipment Lack of supervision Working with new people Unrealistic deadlines
Improvements for Quality Planning	Education and training Testing or measurement of work and products Innovativeness Improve management-worker relations Stronger pre-qualification and bonding criteria Use design-build contract and require quality

Table 4.3 Data from Interview for Quality Planning

The main improvement that was mentioned,

Communication between partners

Partnership is one of the main options and guarantees that may take the form of a single project, agreements or long-term agreements that cover some or strategic projects. Synergistic, collaborative, cooperative effort between contract management and related parties in the project. Project partnership is the most cost-effective, with the same goal setting, maintaining open lines of communication and conflict resolution problem at the same time when they appear. In partnership projects and strategic partnerships, the principle that the parties are trying to work as much as possible as if they were one and the same organization. Various partnerships can be created, for example, between architects, engineers, designers and contractors, between contractors and subcontractors and between the contractor and suppliers. To be effective, requires a commitment from partners, mutual trust and a real discipline. Partners claim to have a positive impact on project performance and improving customer satisfaction, safety and reduced litigation. However, all project managers

supports the benefits of a partnership. Working together requires some of the same elements as the execution of quality, such as the commitment of management, human resources, customer focus and satisfaction, strategic planning, process management, measurement and analysis and last but not least, the culture .

Despite the many successes reported with a partner, and there have also been reports of moderate partners in the project or not. There blockade against partners such as organizational culture and organizational climate and organizational structure. This is not a coincidence that the three obstacles are similar to those barriers that prevent the implementation of quality management. Partners are the construction industry is beginning to realize that organizational change is not a simple process that requires a cultural change is to change the climate in the long term and difficult to achieve and the change in structure. All this requires a lot of effort. Most project managers and contractors that apply partnership require high levels of investment and sources of risk taking in decision making, in particular the staff and middle managers, but in return, construction companies can achieve higher levels of performance.

CHAPTER 5
BENEFITS OF QUALITY PLANNING

Contractors do see obvious benefits of quality. More repeat customers and reduced rework are two of the most cited benefits. There are a lot more advantages and benefits that can be seen in the efforts of quality planning. Firstly, clarification of what services a client expects the practice to provide is obtained. This gives a better understanding and view for the contractors on how to produce the expected structure and designs according to the requirements of clients.

Besides that, there is reduction in loss of time due to re-work or ineffective or inefficient practices. Planning ahead carefully for quality ensures that the time is kept in phase with the supposed schedule timeline. Every task and activity carried are following the advanced planned schedule dates, thus avoiding over run of time.

Moreover, with quality kept as priority in the planning, there will be better communications structure. Planning regular meetings within the parties involve helps the flow of the project. Updating every step of the progress provides better clarification on the status of the project, hence produce better outcome. Communication is one of the most essential elements in planning, as it affects a huge part of the project's movement and phase. There are times, projects are delayed due to misunderstandings between internal or external parties in the team.

Other than that, quality planning also helps provide higher repeat referrals from a satisfied client base. Construction companies will then have higher chances of obtaining project offers in the future. Usually problems in projects are highlighted and resolved in an open manner by implementing quality planning, thus it increased confidence that controls are in place and the risk of error is reduced.

Generally, in quality planning, training for staff in performing their roles would be one of the steps in order to ensure that each and every one of them are clear about the task assigned and knows how to carry it out. This increases the technical area of a particular project as the knowledge of the staff is increased. In addition to that, morale is enhanced by having an effective, well-run practice.

Quality planning also assists company enhanced reputation in the business and social community attributed to members of a professional body that prescribes, demonstrates, and enforces high standards of quality control in an environment of self-regulation. Also gain acceptance by government and the community of the concept of self-regulation of the accounting profession and its effectiveness.

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSION

The purpose of this study was to identify factors that contribute to the effectiveness of high-quality planning construction projects, to analyze the problems encountered in planning for the construction of quality and identify improvements implemented for planning the construction quality of the project. The study was conducted through survey questionnaires, semi-structured interviews and a case study of project managers in Malaysia.

The research results showed that Malaysian construction companies used in the study exposed to light different approach to quality. The results indicated several barriers to planning for quality, including a lack of quality enterprise culture and the difficulty of developing a plan for long-term quality. The case study also showed that most companies are reluctant to change their current practice because clients are not driving a high quality approach based on the selection of the contractor. The observed results indicate that the economic crisis that disrupted over the development of a quality plan. Generation of the results of this study, the following conclusions can be made for the construction industry.

The planning process identified the common quality on the basis of the study will be useful for other contractors, subcontractors especially the lower graduates who do not have a quality system in practice. Therefore, it is important to conduct training programs to improve the knowledge of Malaysian entrepreneurs in these areas and approach to quality planning feasible and attractive enough to participate in the larger

market. The concept of quality planning should still be educated, and a process that is suitable for the construction industry while overcoming the obstacles identified should be developed to achieve better results with investing in quality.

Overall, quality planning is very much effective as it benefits the construction industry to attain a better perception of project purposes, to develop good organization of the operation, eliminate or reduce improbability, and provide a basis for monitoring and controlling work.

6.2 RECOMMENDATIONS

Best measure/indicator of quality in construction projects that should be focused on
Overall customer satisfaction Management commitment to quality Being asked to come back to do more work and Skilled work force Training and education The amount of call backs/rework and Regular inspections The length of warranty (in years) companies can give on their work General construction standards, such as BOCA, CABO, ICC and Quality Awards Certified quality programs such as the ISO 9000 and 14000 series
Important aspects for improving quality in construction projects
Employee involvement Management commitment Skilled workforce Communication between managers and employees Training and education Subcontractors involvement & Organizational culture Well-defined roles and responsibilities Clearly defined goals and objectives Review/analysis used to improve performance Regular inspections and audits Incentives for good performance & Regular meetings Criteria used in pre-qualification in bidding process Written programme or policy

Table 4.4 Recommendations for Quality Planning

Timelines for FYP 2

No.	Detail/ Week	1	2	3	4	5	6	7		8	9	10	11	12	13	14	15
1	Project Work Continues	■	■	■	■	■	■	■									
2	Submission of Progress Report									●							
3	Project Work Continues									■	■	■	■	■			
4	Pre-EDX												●				
5	Submission of Draft Report													●			
6	Submission of Dissertation (soft bound)														●		
7	Submission of Technical Paper														●		
8	Oral Presentation															●	
9	Submission of Project Dissertation (Hard Bound)																●

Mid-Semester Break

● Suggested milestone

■ Process

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APPENDICES

Appendix A: Survey Questionnaire form

QUESTIONNAIRES

Quality planning in construction project

Study important aspects of quality planning in construction project

Study problems of quality planning in construction project

This questionnaire consists of three parts. First part is regarding the respondents' general information, while the second part is a questionnaire for determining important aspect in quality planning. Lastly, third part is questionnaire to investigate problems of quality planning. The respondents are specifically reminded of the importance of observing consistency in their answers. Their responses should not be biased towards any particular project whether it was highly successful or disastrous. Any information obtained through this questionnaire will stringently be used for educational use. All the data information will be on aggregated basis and no individual data will be published. If more information's are required, please contact Ms. Nor Atiqah binti Zainal by phone 017-2772141 or email to tqaz90@gmail.com

SECTION A : GENERAL INFORMATION

Name of respondent :
……

Name of respondent's company :
……

Location of respondent's company :

…….

Respondent’s designation :

……..

Respondent’s experience (years) in construction :

……..

Area of experience in quality planning :

…….

For each statement below please tick / on the appropriate number to indicate whether it is:

1 - STRONGLY DISAGREE 2 - DISAGREE 3 - MODERATELY
4 - AGREE 5 - STRONGLY AGREE

SECTION B : IMPORTANT ASPECT OF QUALITY PLANNING

1. Benefit/Cost Analysis

	1	2	3	4	5
To determine if it is a sound investment/decision					

(justification/feasibility), and to provide a basis for comparing projects. It involves comparing the total expected cost of each option against the total expected benefits, to see whether the benefits outweigh the costs, and by how much.

2. Benchmarking

Comparing one's business processes and performance metrics to industry bests or best practices from other industries.

3. Flowcharting

Type of diagram that represents an algorithm or process, showing the steps as boxes of various kinds, and their order by connecting these with arrows.

4. Design of Experiments (DOE)

Use the design of any information-gathering exercises where variation is present, whether under the full control of the experimenter or not.

5. Cost of Quality

Uses the price of creating a quality product, it's the cost of not creating a quality product.

6. Quality Audits

The process of systematic examination of a quality system carried out by an internal or external quality auditor or an audit team to ensure that the institution has clearly defined internal system monitoring procedures linked to effective action.

7. Control Charts

To determine if a manufacturing or business process is in a state of statistical control.

8. Pareto Diagram

Use chart that contains both bars and a line graph, where individual values are represented in descending order by bars, and the cumulative total is represented by the line.

9. Statistical Sampling

Selection of a subset of individuals from within a statistical population to estimate characteristics of the whole population.

10. Trend Analysis

Collecting information and attempting to spot a pattern, or trend, in the information.

11. Any other methods

SECTION C : PROBLEMS OF MATERIAL MANAGEMENT

	1	2	3	4	5
1) Lack of Communication					

Lacking open communications and mutual support that derived from trust-based relationships among project participants to effect substantive quality improvement.

	1	2	3	4	5
2) Performance Problems					

Performance problems are often related to the projects not meeting product specifications, not meeting capacity requirements, mechanical problems, electrical problems, instrumental problems and miss-operation.

	1	2	3	4	5
3) Accidents incl. Explosion and Fire					

Accidents that usually occur during construction projects, such as accidents caused by design faults, accidents caused by miss-operation, accidents caused by construction faults, fire caused by loose safety procedures and insufficient fire safety.

	1	2	3	4	5
4) Construction Quality Problems					

The quality of soil, improper concrete foundations, tolerances, material identification, welding rod mistakes, short-cuts in construction and design errors.

	1	2	3	4	5
5) Logistics Problems					

Packing and storing not properly done, damages during transportation, difficulty in customs clearance and difficulty and problems encountered during transportation.

6) Procurement Mistakes

The common mistakes relating to procurement are error in specifications, vendor's design mistakes, vendor's fabrication problems and faults found at inspection and test.

7) Design Mistakes

Calculation mistakes often occur due to carelessness, inexperienced and lack of knowledge regarding designs and material selection. Not enough analysis on design, as well as not knowing the proper short-cut of designs is also common mistakes.

8) Management Mistakes in Proposal

Estimation error due to wrong estimation method or could also be because of the insufficient in-house cost data. In other cases, the contractor bid on a bid was not supposed to be made.

Appendix B: Average Index Formula

The analysis was based on the qualitative measurement or ranking system. Rating for the questionnaire are 1 – Totally Disagree, 2 – Disagree, 3 – Moderately, 4 – Agree, 5 – Totally Agree.

The Average Index Formula:

Average Index :

$$\frac{\sum(\beta x n)}{N}$$

Where, ß is weighing given to each factor by respondents
n is the frequency of the respondents
N is the total number of respondents

With the rating scale as below (Majid & McCaffer, 1997)

- 1 = Never/Totally disagree ($1.00 \leq$ Average Index < 1.50)
- 2 = Rarely/disagree ($1.50 \leq$ Average Index < 2.50)
- 3 = Sometimes/Neutral ($2.50 \leq$ Average Index < 3.50)
- 4 = Often/agree ($3.50 \leq$ Average Index < 4.50)
- 5 = Very often/strongly agree ($4.50 \leq$ Average Index < 5.00)