CASE STUDY ON QUALITY MANAGEMENT SYSEM (QUALITY ASSURANCE AND QUALITY CONTROL) IN CONSTRUCTION PROJECTS

by

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CERTIFICATION OF APPROVAL

Case Study On Quality Management System (Quality Assurance and Quality Control) In Construction Projects

by

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Approved by,

_____

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UNIVERSITI TEKNOLOGI PETRONAS
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May 2014

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.

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BUDIMAN AMAT

ABSTRACT

In a project or a process of the making of a product, quality is always a priority. In a building construction or infrastructure, the quality is also the main interest of the investor or owners of the properties. There are some methodology used to determine the quality of the product which has been enact in the ISO 9000 as a quality guidelines and management. In the process of making a product, there are Quality Assurance (QA) and Quality Control (QC). This two (2) things are the documentation used in order to ensure the quality of the product. QA is a tool or documentation used to plan a corrective method or plan to avoid defects while QC is the process or activity to ensure that the product meets the QA standards. However, these two things are being carried out differently by each company. Some company may have only 5-6 forms in order to achieve their target and some company uses more than 10 different forms to achieve their standards. These forms usually proposed by the contractors but some has been prepared by the consultant or owner itself. In this case study, the importance of QA/QC will be determine and the causes of poor QA/QC management or evaluation or standardization will be determine by evaluation from the questionnaire and an interview to the selected body or company. This is to determine the ability of our local company in producing products with proper standards.

ACKNOWLEDGMENT

First and foremost, I would like to express my gratitude to my project supervisor; Ir Idris bin Othman for his supervision. He has provided me precious time for series of discussions, valuable guideline, comments and ideas as well as his kind assistant. I also would like to express my appreciation to SCHB Engineering Sdn Bhd for their kind assistance and willingness to help me in gaining the information about my project. SCHB Engineering Sdn Bhd is the company that I have done my internship before. Not to forget a few companies that help me finished my survey questionnaire and also spend their time for me to do the interview.

I would like to extend my sincere gratitude to all lecturers of Civil Engineering Department that impart their wisdom and knowledge and the supporting staff for their cooperation and assistance throughout my 4 years study in UTP. Last but not least, thanks to all individual that impair apart either directly or indirectly of which contributed in the completing of this project and finishing the task given to me.

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ABBREVATIONS AND NOMENCLATURES

QMS	-	Quality Management System
QMP	-	Quality Management Plan
QAQC	-	Quality Assurance and Quality Control

CHAPTER 1

1.0 INTRODUCTION

All companies throughout the whole world must have their own standards for their products in order to ensure the satisfaction of their client. Including construction sector, there are also consideration of quality of their product such as the workability of their product or building etc..

For construction, there are three (3) major consideration which are the Quality, Time and Cost. Generally, quality means the standard of something as measured against other things of a similar kind or the degree of excellence of something. Quality in construction industry means that the constructed building can achieve its target in terms of workability if it meets the standards as requested. The tools to ensure the quality of the building are by having Quality Assurance (QA) and Quality Control (QC)

Quality Assurance and Quality Control (QA/QC) is a tool of determining the quality of the product or the construction. Quality Assurance (QA) is a way of preventing mistakes or defects in manufactured products and avoiding problems when delivering solutions or services to customers. QA is applied to physical products in pre-production to verify what will be made meets specifications and requirements, and during manufacturing production runs by validating lot samples meet specified quality controls. QA is also applied to software to verify that features and functionality meet business objectives, and that code is relatively bug free prior to shipping or releasing new software products and versions.

Quality control (QC) emphasizes testing of products to uncover defects and reporting to management who make the decision to allow or deny product release, whereas quality assurance attempts to improve and stabilize production and associated processes to avoid, or at least minimize, issues which led to the defects in the first place.For contract work, particularly work awarded by government agencies, quality control issues are among the top reasons for not renewing a contract.

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). As 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).

Qualities are checked for operating procedures and materials. As for an example, for operating procedures, the method of concrete pouring. In some projects, the pumping flowrate of concrete are specified and the curing time are determined in the QA and the operator must comply with the standard given. The QA standards are given to ensure that the concrete able to achieve its mission or workability standard. As for the QC, a proper inspection to be conducted to ensure that the operating procedure stated in the QA is perfectly complied by the workers on site.In

this case study, the determination of the implementation of the QA/QC will be evaluated to determine the best way of implementing these procedure in a construction process. Failure to meet quality requirements in either dimension can have serious consequences for any or all the project stakeholders (Khan, Azhar & Mahmood, 2008).

1.2 PROBLEM STATEMENT

The problem of this research are to determine:

- What are the importance of implementing the Quality Assurance and Quality Control?
- What are the causes and the effects of poor Quality Assurance and Quality Control Management?

1.3 OBJECTIVES

The objectives of the research are to determine:

- The importance of Quality Assurance and Quality Control implementation
- To identify the factor effecting the Quality Assurance and Quality Control Management and its consequences to the project.

1.4 SCOPE OF WORK

The scope of work for this project will focus on the quality management and implementation of QA/QC in Malaysia. In this case, this project will rely on the project manager's point of view. It is targeted to determine the

importance of QAQC implementation. Furthermore, to determine the causes of problems and how it effects the quality of the product. It is also to determine the problems faced during construction and how to rectify the case to ensure that the project will be completed on time, smoothly and also with expected product quality.

CHAPTER 2

2.0 LITERATURE REVIEW

Quality is the characteristic element of an item that can be evaluated as a meeting standard, whereby 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).

The Principles of Quality Management System

Quality Management System (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).

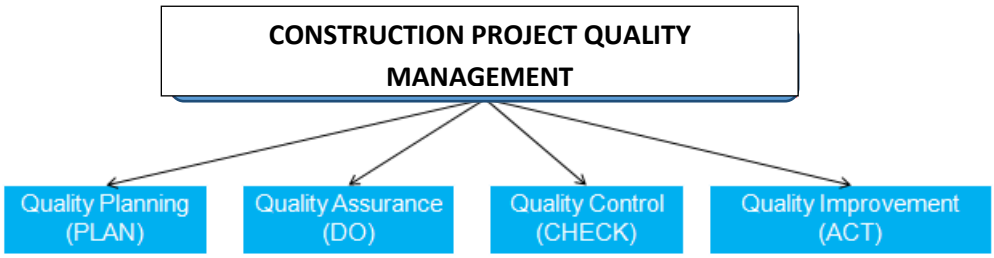

Figure 1.0: Approaches to conformance in Quality Management

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). Listed below are the other key aspects of Quality.

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).

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.

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.

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 has

been recognized that can be utilized within any management team which will allow the organization 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.

2.1 KEY PROJECT MILESTONE

PROJECT KEY MILESTONE/WEEK	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PROGRESS WORK CONTINUES														
QUESTIONNAIRE DISTRIBUTIONS														
CONDUCTION OF INTERVIEW														
SUBMISSION OF PROGRESS REPORT														
DATA COLLECTION														
DATA ANALYSIS														
PRE-SEDEX														
SUBMISSION OF DRAFT FINAL REPORT														
SUBMISSION OF TECHNICAL REPORT														
SUBMISSION OF DISSERTATION (SOFT BOUND)														
VIVA														
SUBMISSION OF PROJECT DISSERTATION (HARD BOUND)														

Process

Suggested Milestone

Table 1.0

As shown in the project milestone in table 1.0, the progress of questionnaire and interview progress have exceeded the suggested milestone. Although, with maintaining good relation and the cooperation with the related company, the data collection phase is able to be managed and obtained before Pre-SEDEX.

As there are obstacles in making contacts with the interviewee, however, the response and cooperation given are manageable and still possible to be held within time. The questionnaire distribution has been postponed due to finalization of questionnaire.

In this situation, an alternative key milestone has been prepared due to unexpected situation. The alternative's is as shown in table 2.0.

PROJECT KEY MILESTONE/WEEK	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PROGRESS WORK CONTINUES														
QUESTIONNAIRE DISTRIBUTIONS														
CONDUCTION OF INTERVIEW														
SUBMISSION OF PROGRESS REPORT														
DATA COLLECTION														
DATA ANALYSIS														
PRE-SEDEX														
SUBMISSION OF DRAFT FINAL REPORT														
SUBMISSION OF TECHNICAL REPORT														
SUBMISSION OF DISSERTATION (SOFT BOUND)														
VIVA														
SUBMISSION OF PROJECT DISSERTATION (HARD BOUND)														

Process

Suggested Milestone (Original)

Suggested Milestone (Alternative)

Table 2.0

As of the alternative key milestone chart, all the data and results have been obtained and excellently according to the alternative key milestone.

CHAPTER 3

3.0 METHODOLOGY

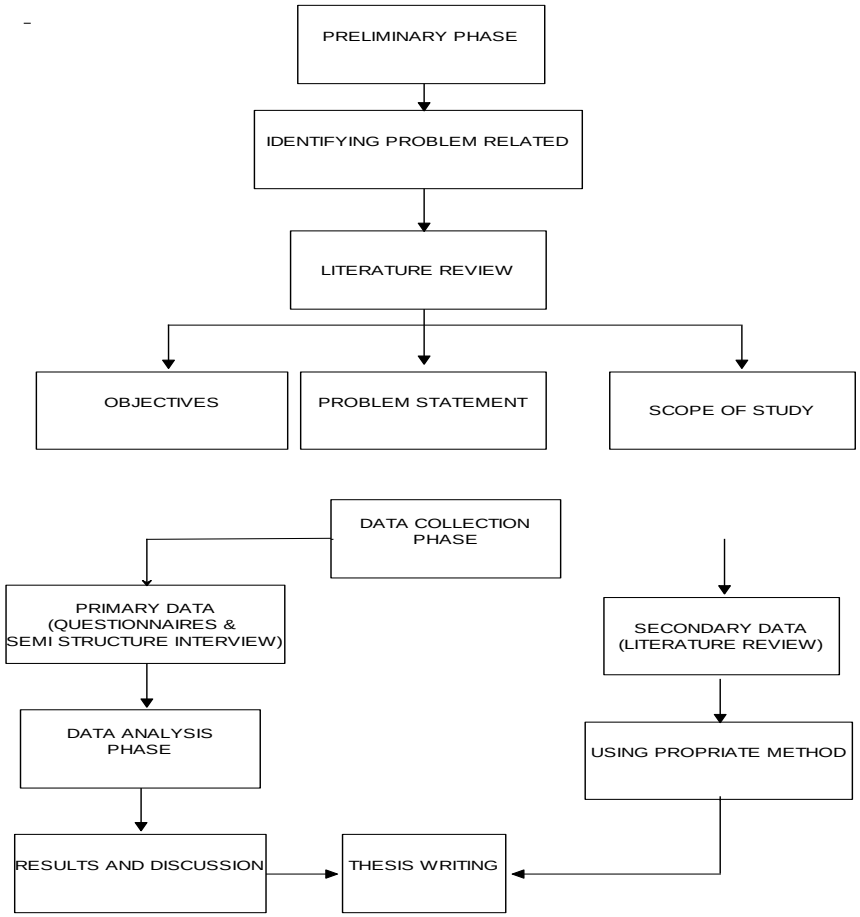

Figure 2: Project Flow

For this project methodology phase, the steps will be following and based on the flowchart shown above. There are two phases in the methodology which are Preliminary Phase or Literature Review Phase and Data Collection Phase.

3.1 DATA COLLECTION

Data Collection phase is 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, researches, 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 and referred as related companies.

3.1.1 PRIMARY DATA

Primary data is where the data will be gathered by conducting a semi-structure interview and distribution of questionnaires to related companies. For the interview, the interviewee has been acknowledged and yet to be confirmed and conducted due to pending approval and time suitability.

Other than that, the questionnaires distribution is yet to be carried out due to improvements has been made to the questionnaire so that it will produce better and precise results so that this research can obtain a quality research result and hopefully may be used and be taken seriously in the future.

The interview will be conducted as approval has been obtained and suitable time has been confirmed. As for the questionnaire, it will be distributed as the relevant questions for the questionnaire has been confirmed and has been found inevitable.

Survey Questionnaire

Questionnaires are a common method of gathering data (Sharp, Peters and Howard, 2002). Survey research, which relies on

questioning, is a systematic way of collecting data from a number of respondents according to Krysik and Finn (2010).

Tayie (2005) states that, the flexibility of survey has made it become one of the most widely used methods of media research. The purpose of approach, questionnaire design, sampling, and the way to analyze and interpret data has to be considered before a survey is conducted (Tayie, 2005).

According to Krysik and Finn (2010), survey research is a popular method of gathering data in social work research. It relies on questioning and is a systematic way of collecting data from a number of respondents. They stated that survey can be used to determine what respondents know, believe, or feel or how they say they behave. Other than that, some surveys also ask respondents to describe what they have done or how they felt in the past, or to speculate about their future intentions (Krysik and Finn, 2010).

a) Questionnaire Design

The questionnaire will divide into three sections. Section A will request background information about the respondents. The respondents are requested to answer question pertaining the location of their company based in, the type of their organization, their position in construction industry, their working experience in construction industry and the primary type of projects which they are involved in. Section B of the questionnaire is asking about the importance of the QA/QC implementation and Section C is asking about the impacts of poor QA/QC implementation.

The survey questionnaire is designed with two option which online survey and hardcopy in order to ease the respondents to answer the survey. Moreover, the online survey will save the respondent's time and thus they will be less reluctant to participate in this survey questionnaire.

b) Analysis data

i) Data Analysis Method

Statistical Package for Social Sciences (SPSS) is the software which designed to carry out the data analysis with comprehensive statistical tests. The collected data from the survey questionnaire will be analyzed by using SPSS in order to carry out the data analysis in this research.

ii) Descriptive Statistic Method

Descriptive statistic method is the simplest method of analysis. This method provides a general view of the results and it will either analyze the responses in percentages or will contain actual numbers (Naoum, 2007).

iii) Relative Importance Index

The data from Section B and C in questionnaire survey will be analysis by using Relative Importance Index (RII). It will be used to determine the relative importance of the various causes and effects of site issues. The seven-point scale ranged from 1 (extremely disagree) to 5 (extremely agree) was adopted and transformed to relative importance indices (RII) for each factor as follows:

$$RII = \frac{\sum w}{A \times N},$$

where W is the weighting given to each factor by the respondents (ranging from 1 to 5), A is the highest weight (i.e.5 in this case), and N is the total number of respondents. The RII value had a range from 0 to 1 (0 not inclusive), higher the value of RII, more important was the cause or effect of site issues. The RII was used to rank (R) the different causes. These rankings made it possible to cross-compare the relative importance of the factors as perceived by the three groups of respondents (i.e. clients, consultants and contractors). Each individual cause's RII perceived by all respondents were used to assess the general and overall rankings in order to give an overall picture of the causes of site issues in Malaysian construction industry. The same procedure was adopted for ranking the effects. The indices (RII) were then used to determine the rank of each item (impact). These rankings made it possible to cross compare the relative importance of the items as perceived by the three groups of

respondents. The weighted average for each item for the three groups of respondents was determined and ranks (R) were assigned to each item representing the perception of the three groups.

3.1.2 SECONDARY DATA (LITERATURE REVIEW)

Literature Review phase or Preliminary phase 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.

CHAPTER 4

4.0 RESULT AND DISCUSSION

4.1 RESULT

In this chapter, the result will be based on the questionnaire and interviews which as described in the methodology in Chapter 3. This result will determined whether the objectives of this research has been achieved or otherwise. The result from the questionnaire will be illustrated in graph as it will be compared with the responds and opinions obtained from the interview.

4.1.1 RESULT FOR QUESTIONNAIRE SURVEY

(Primary Data)

In this chapter, the results obtained from the questionnaire survey will be presented and discussed.

a) Section A (Respondents' Demographics)

The primary data collected from the section C of the questionnaire was analyzed from the perspective of developer, PMC, consultants and contractors. The calculation of RII and ranking were done as explained in the previous section.

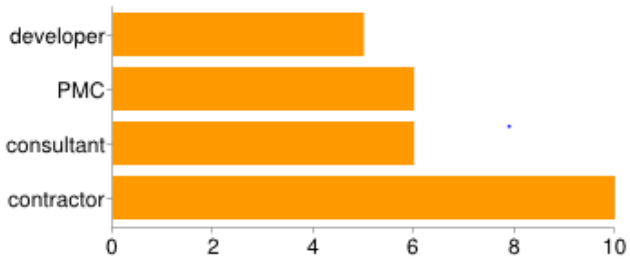

Figure 3: Type of Organization

The pie chart above shows that the 20 sets of returned questionnaires consist of four main types of organizations, which includes developer, project management consultant, consultant, and contractor. According to the result, most of the respondents were contractor firms, which is 37%. Then, it followed by the consultant and PMC firms, which is 22%.

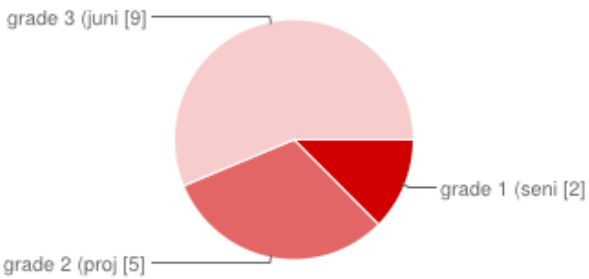

Figure 4: Types of Position

The data analysis was demonstrating the respondent position in construction project. Based on 20 returned questionnaires, the greatest number of the respondent profession is grade 3 in the questionnaire (junior engineer, supervisor, etc..) which is 56%. Apart from that, there is 31% are working as grade 2 (project engineer, quantity surveyor, etc..) in construction project and it was followed by the grade 1 (managers, section head, etc..), which is 13%.

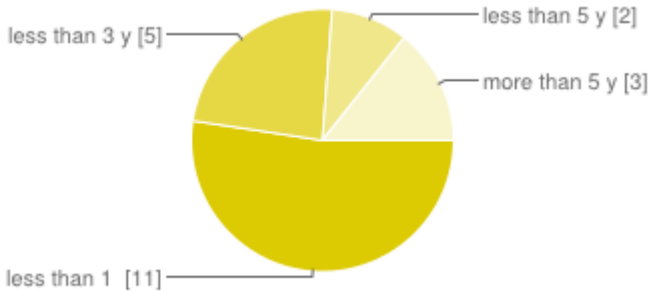

Figure 5: Years of Working Experience

Based on 20 returned questionnaires, the result indicating the greatest number of respondents working experience in construction project is at the range of less than 1 year which is 52%. On the other hand, there is 25% respondent is falling in the range of working experience less than 3 years. Additionally, 14% of respondents has working experience of more than 5 years and 10% of respondents has working experience a

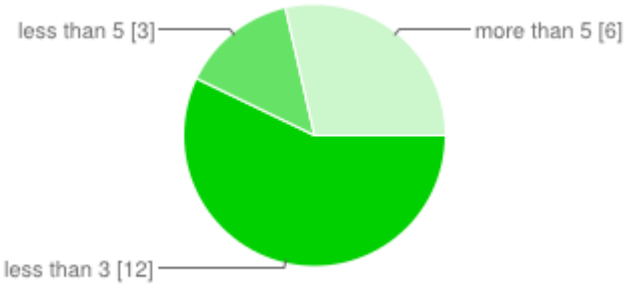

Figure 6: Numbers of Projects Involved

According to the result, the most of the respondents has involved in less than 3 projects which is 57%. Other than that, 29% of the respondents have been involved in more than 5 projects and 14% have involved in less than 5 projects.

b) Section B (Importance of QA/QC implementation)

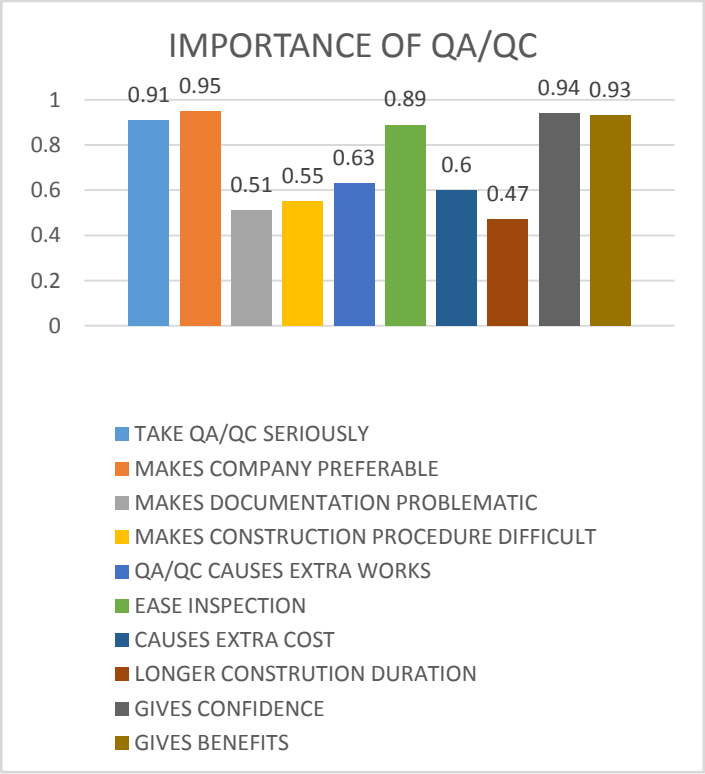

Figure 7: Importance of QA/QC implementation

The primary data collected from the section B of the questionnaire was analyzed from the perspective of developer, PMC, consultants and contractors. Each individual cause's RII perceived by all respondents was computed for overall analysis. The relative importance index, RII, was computed for each cause to identify the most significant causes. The causes were ranked based on RII values. From the ranking assigned to each importance, the most important issues in Malaysian construction industry were able to identify. Based on the graph, the five most important causes of site issues as perceived by developers, PMCs, contractors and consultants were: (1) makes company preferable (RII = 0.95); (2) gives confidence in the products presented (RII = 0.94); (3) gives benefits to the organization (RII = 0.93); (4) takes QAQC issues seriously (RII = 0.91) and (5) makes inspection works easier (RII = 0.89).

c) Section C (Effects of poor QAQC implementation)

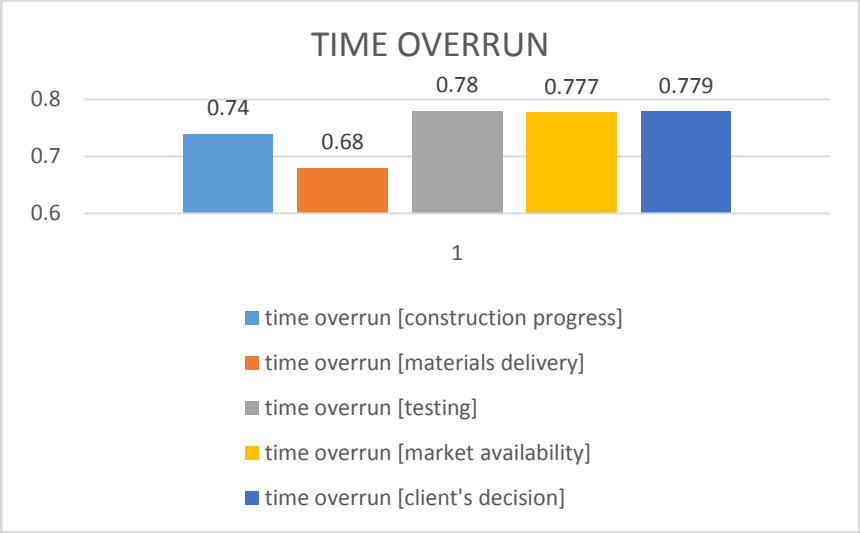

Figure 8: Time Overrun

In this RII rank, it shows that the most important issues in time overrun is for testing (RII=0.78). This may be caused by unsatisfied clients with the result given which not as expected. Followed by client's decision (RII=0.779) which only slightly lower than testing. After that comes the construction progress (RII=0.74) and finally materials delivery (RII=0.68)

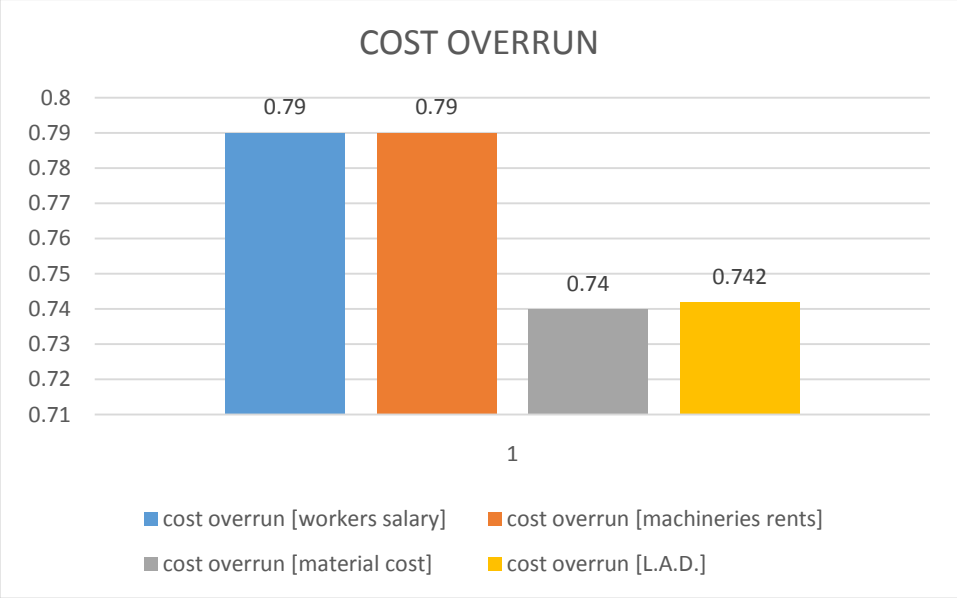

Figure 9: Cost Overrun

Cost is usually the most important issue in construction project. From the result, it shows that the most affected and important costs due to poor QAQC implementation are for workers salary and machineries rents (RII=0.79), and the others follows with L.A.D. (RII=0.742) and material cost (RII=0.74).

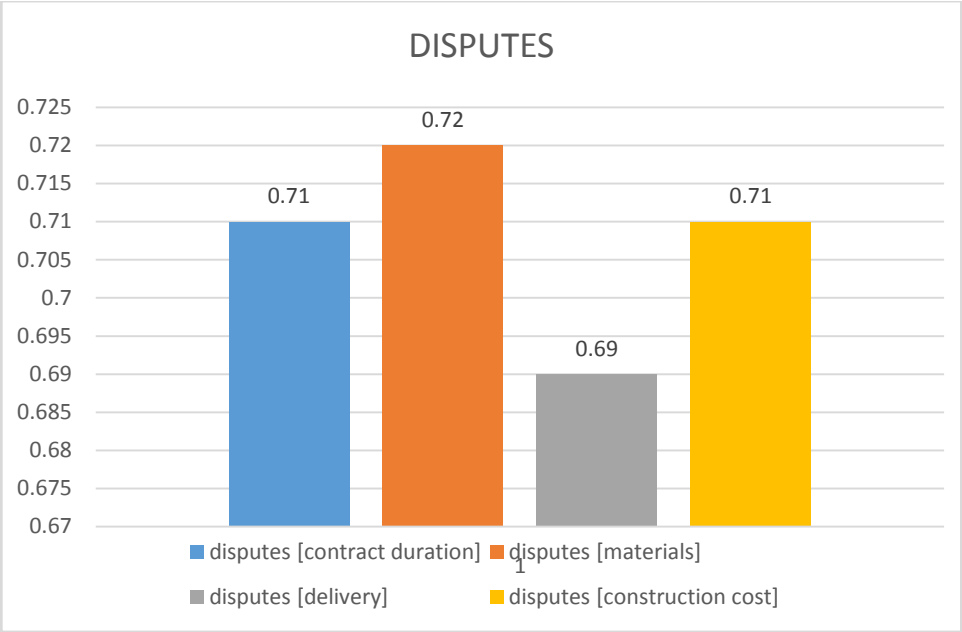

Figure 10: Disputes

As from the result, respondents shows that the disputes upon materials is the most important (RII=0.72). Followed by contract duration and construction cost (RII=0.71) and last but not least delivery (RII=0.69)

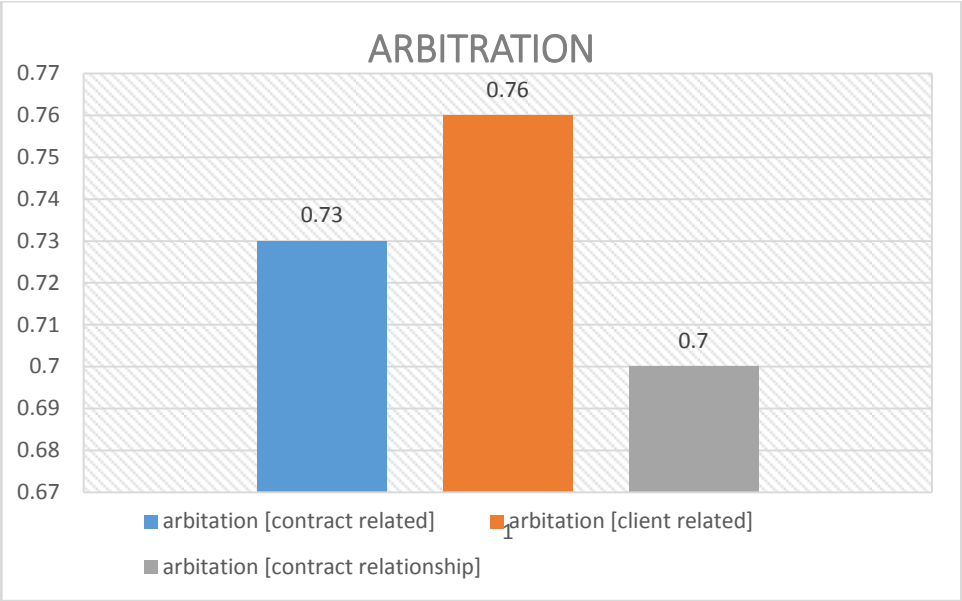

Figure 11: Arbitration

Arbitration on client related is the most important (RII=0.76) followed with contract related (RII=0.73) and contract relationship (RII=0.7). From this result, the importance of effected arbitration caused by poor QAQC implementation is almost even. The arbitration among these three issues are almost equally affected.

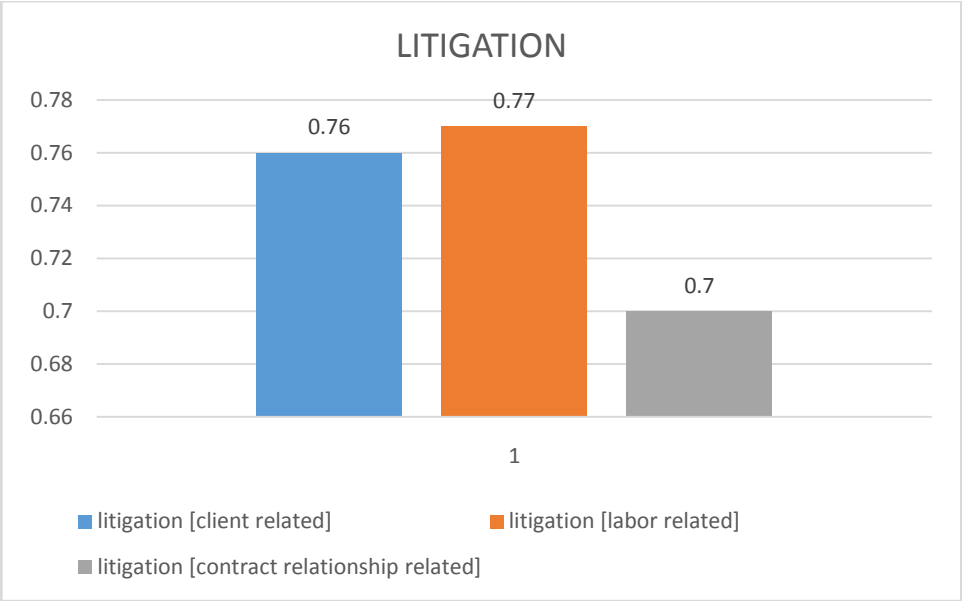

Figure 12: Litigation

As of figure 10, the litigation of labor related is the most important factor (RII=0.77). This may be due to the doubts of competencies and other losses caused or investigated to lead to the labors. With only RII difference of 0.01 which is by client related and followed by contract relationship litigated (RII=0.7)

With all the results as shown above, the author has summarized all five affected factors due to poor QAQC implementation which are time overrun, cost overrun, disputes, arbitration and litigation to find the most important factors which affected due to the poor QAQC.

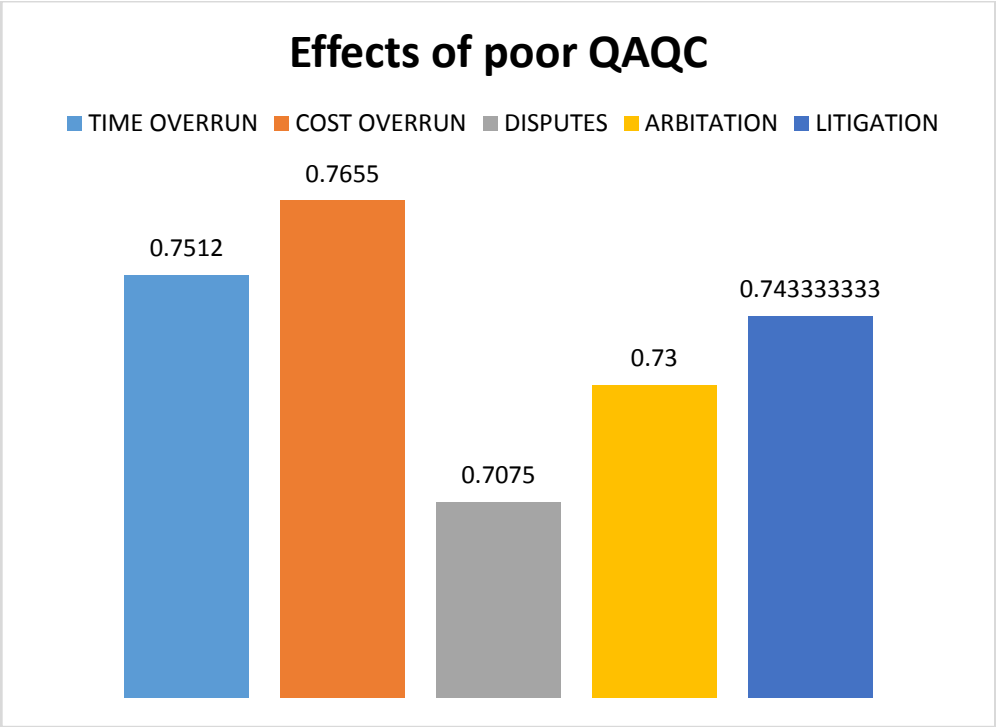

Figure 13: Effects of Poor QAQC Implementation

Based on the ranking, the important effects of poor QAQC as perceived by developer, PMC, consultants and contractors were: cost overrun (RII = 0.7655), time overrun (RII = 0.7512), litigation (RII = 0.7433), arbitration (RII = 0.73), litigation (RII = 0.4429), and disputes (RII = 0.7075).

4.1.2 RESULT FOR LITERATURE REVIEW

(Secondary Data)

In this section, all the literature researches has been listed in table 1.0 and 2.0 as it shows its objectives and gaps. The research gathered has been analyzes as for its relevancies. There are all sixteen (16) research papers and seven (7) of the papers are listed in the table from local and international authors has been used as

reference as for insurance and clarification into determination to achieve current research objectives.

Table 3.0 Findings in Literature

No.	Author	Project Title	Findings
1	David Arditi and H Murat Gunaydin	Total Quality Management In The Construction Process (1997)	• The construction project should be considered as a process where all customers must be satisfied. These customers include internal customers (employees, units, departments within an organization) and external customers (owner, designer, contractor, etc.). • The requirements of the owner must be clearly defined at the beginning of the project and be agreed to by both the owner and design finn. The more time and effort are spent at the beginning in defining requirements, the more smoothly the project will progress. Objective setting is important because it provides a focus for scope definition, guides the design process, controls the construction process, and influences the motivation of the project team.
2	Ayman H. Al-Momani	Examining Service Quality Within Construction Process (2000)	• There was an almost complete lack of attention devoted to owner's satisfaction which undoubtedly contributed to poor performance. • Managing the construction so that all the participants perceive equity of benefits can be crucial to project success. To succeed as an innovator, design and construction firms must not only manage the construction process but recognize the needs of a client and should base their management instruction on quality.
3	Jaak Tepandi	Quality Assurance of Knowledge-Based System (1997)	• No VTV can improve a badly designed system, so high quality development methods and tools are of primary importance for safety-related systems. • Although issues such as KBS completeness, consistency, validation and some others, are specific to these systems and have received the attention they deserve, there exist a number of practical problems in KBS VTV that have not been adequately investigated.
4	Harm Tillema,	Assessing assessment	• Specific quality criteria are taken into account in relation to precise steps in

	Martijin Leenknecht, Mien Segers	quality: Criteria for quality assurance in design of (peer) assessment for learning – A review of research studies (2011)	the assessment cycle, while others have a more generic deployment. • Quality criteria in first steps of the assessment cycle (i.e., setting assessment goals and selecting assessment tasks) were specifically related to representativeness, content coverage and content fidelity while these criteria were less prominent in later steps. • The criteria fairness and transparency were considered applicable to all steps of the assessment cycle. • Criteria use in quality assurance is mainly arranged to produce clear and meaningful assessment tasks which can warrant instructional implications for further learning.
5	Ilias Said, Abd Rahaman Ayub, Arman Abd Razaki, & Tee Kuan Kooi	FACTORS AFFECTING CONSTRUCTION ORGANIZATION QUALITY MANAGEMENT SYSTEM IN THE MALAYSIAN CONSTRUCTION INDUSTRY (2009)	• Majority of the respondents suggested the main advantages of implementation of QMS are "Enhanced Image and Reputation of Organization" followed by "Performance Improvement and Increased Customer Satisfaction".
6	Tiong Kung Leong, Norhayati Zakuan, & Muhamad Zameri Mat Zaman	Quality Management Maintenance and Practices- Technical and Non-Technical Approaches (2012)	• There are lots of studies in the literature discuss quality management practices and human behavioral issues which are relevant to technical and non-technical approaches, but there has been little research into the definition and application of non-technical approaches.
7	Murali Sambasivan, & Yau Wen Soon	Causes and effects of delays in Malaysian construction industry	• We identified main causes of delay and ten most important causes were: (1) contractor's improper planning, (2) contractor's poor site management,

		(2007)	(3) inadequate contractor experience, (4) inadequate client's finance and payments for completed work, (5) problems with subcontractors, (6) shortage in material, (7) labor supply, (8) equipment availability and failure, (9) lack of communication between parties, (10) mistakes during the construction stage. • We identified main effects of delay and they were: (1) time overrun, (2) cost overrun, (3) disputes, (4) arbitration, (5) litigation, (6) total abandonment.

As shown above, there are series of researches which have been made by various researchers from Malaysia and other countries. Unfortunately, there are gaps or unclarified matters especially on improving the QMS implemented. Below is the list of gaps which are identified from the same researches as Table 1.0.

No.	Author	Project Title	Gaps
1	David Arditi and H Murat Gunaydin	Total Quality Management In The Construction Process	• The authors did not mention on how to make sure that the clients received what he deserved.

		(1997)	
2	Ayman H. Al-Momani	Examining Service Quality Within Construction Process (2000)	• The author does not mention on how the implementation of Quality Assurance and Quality Control should be carried out. • The author also does not mention on what are the consequences of poor implementation of Quality Assurance and Quality Control.
3	Jaak Tepandi	Quality Assurance of Knowledge-Based System (1997)	• Learning, audio-visual and natural language systems have remained outside the scope of the paper.
4	Harm Tillema, Martijin Leenknecht, Mien Segers	Assessing assessment quality: Criteria for quality assurance in design of (peer) assessment for learning – A review of research studies (2011)	• The authors did not mention on how to improvise the method that he/she is referring to.
5	Ilias Said, Abd Rahaman Ayub, Arman Abd Razaki, & Tee Kuan Kooi	FACTORS AFFECTING CONSTRUCTION ORGANIZATION QUALITY MANAGEMENT SYSTEM IN THE MALAYSIAN CONSTRUCTION INDUSTRY (2009)	• In this paper, they have mentioned about the advantages of implementation of QMS in general.
6	Tiong Kung Leong, Norhayati Zakuan, & Muhamad Zameri Mat Zaman	Quality Management Maintenance and Practices- Technical and Non-Technical Approaches (2012)	• The authors are emphasizing on the importance and the disadvantages of poor human behavior during the implementation of quality management and the differences of technical and non-technical approaches.
7	Murali Sambasivan,	Causes and effects of delays in Malaysian	• The authors did not explain on how to

	&Yau Wen Soon	construction industry (2007)	overcome the matters arises.

Table 4.0 Gaps in Literature

From the table 1.0 shows that both international and local authors agrees that by implementing QMS procedure will obtained the client's satisfaction as mentioned by David Arditi and H Murat Gunaydin (1997) that the construction project should be considered as a process where all customers must be satisfied. As supported by H. Tillema, M. Leenknecht, and M. Segers (2011), criteria use in quality assurance is mainly arranged to produce clear and meaningful assessment tasks which can warrant instructional implications for further learning which supporting Murali S. and Yau W. S. (2007) which has listen ten (10) main caused of delay and six (6) effects of delay which can be avoid by the implementation of QA/QC in the QMS.

4.2 DISCUSSION

As from the primary result, the respondent shows that 72% admits that their company or organization takes QAQC implementation. On the questionnaire, this 72% checked box number five (5) which indicates for extremely agree, and 14% checked box number four (4) which indicates agree and another 14% checked box number three (3) which indicates between agree and disagree.

Although there is 14% respondent shows their carelessness in QAQC, should not be forgotten that there are overalls of 86% them which cares about QAQC and it is the majority. This indicates that the Malaysian construction industry cares about the implementation of QMS.

As of the result in section C from the questionnaire, there are none of the respondent shows their disagreements. This indicates that QMS implementation is important in order to avoid all of those unwanted events and issues which are cost overrun, time overrun, disputes, arbitration and litigation.

As from the secondary data gathered, engineers throughout the world are agreed to emphasize and to take QMS seriously in order to meet the client's requisition and to produce better products. As mentioned by Ayman H. Al-Momani (2000) which refers to the human behavior should be overcome by implementing the BSEN 9000 (BSEN 9000, 2005), associated with the ISO 9000 quality management system which has listed eight (8) quality management values which will assist in overcoming the human behavioral problems.

CHAPTER 5

5.0 CONCLUSION

As for the conclusion, the project proposed is to determine the factors that contributed to the effectiveness of the product quality and to investigate on how the company in Malaysia implemented the QA/QC procedure. This is to determine the ability of our local company in producing products with proper standards.

The author investigated the importance and effects of poor QAQC implementation in the Malaysian construction industry. A questionnaire was designed and distributed among the four major groups of participants (developers, PMCs, consultants and contractors). The author identified main effects of poor QAQC implementations and most important reason to implement QAQC were: (1) makes the company preferable, (2) gives confidence to the presented products, (3) gives benefits to the company in any conditions, and (4) makes the inspection works easy. The author identified main effects of poor QAQC implementation and they were: (1) cost overrun, (2) time overrun, (3) litigation, (4) arbitration, and (5) disputes. As an important contribution, the author also studied the empirical relationships between the importance and effects of QAQC implementation.

The literatures are collected and gathered from all across the country due to improvising and as a comparison to the method implemented from other countries with methods which Malaysia is implying nowadays. The standards may have different due to each country's ability in terms of technology and

suitability. However, this research is evaluating on the implementation, factors of implementation and the importance of QA/QC procedure in Malaysia.

As measured from the literature review, objective number one (1): The importance of Quality Assurance and Quality Control implementation, has been achieved as D. Arditi and H Murat G., Total Quality Management in the Construction Process(1997) has mentioned that the construction project should be considered as a process where all customers must be satisfied.

Other than that, local authors also supporting the act of good implementation of QA/QC as written by Ilias S., Abd Rahaman A., Arman A. R., & Tee K. K., Factors AffectingConstruction Organization Quality Management in the Malaysian Construction Industry (2009) mentioned that majority of the respondents suggested the main advantages of implementation of QMS are "Enhanced Image and Reputation of Organization" followed by "Performance Improvement and Increased Customer Satisfaction". This indicates that Malaysians are emphasizing the importance in implementing QMS procedure in order to ensure the client's satisfactions.

CHAPTER 6

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CHAPER 7

APPENDICES

Questionnaire Form

UNIVERSITI TEKNOLOGI PETRONAS
engineering futures

QUESTIONNAIRE SURVEY TO

CASE STUDY ON QUALITY MANAGEMENT SYSTEM (QUALITY ASSURANCE AND QUALITY CONTROL) IN A CONSTRUCTION PROJECT

Objective

The goal of this study is to analyze the importance of Quality Assurance and Quality Control implementation and to identify the factor effecting the Quality Assurance and Quality Control Management and its consequences to the project.

Instruction:

1. Please fill in the space available and tick(/) in the respective box
2. All information's will be treated as **CONFIDENTIAL** and shall be used for academic purposes only.
3. All the data will be aggregated and no individual data will be published.
4. If more information is required, please contact Mr. Budiman Amat at:

   Phone: 016-823 6013

   Email: budimanamat89@gmail.com

General

The questionnaire is divided into 3 sections, which are decided below:

1. Section A – General Information
2. Section B – The importance of QA/QC implementation
3. Section C – The impacts of poor QA/QC to construction project

*Notes:

QMS : Quality Management System
QMP : Quality Management Plan
QA/QC : Quality Assurance and Quality Control

SECTION A: GENERAL INFORMATION

Name of Company/Organization :

Name :

Position :

Years of working experience :

No. of projects involved :

Gender : ☐ Male ☐ Female

Age :

SECTION B : THE IMPORTANCE OF QA/QC IMPLEMENTATION

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

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

5 – STRONGLY AGREE

1. Does this company/organization take serious/make compulsory of QA/QC implementation?

1	2	3	4	5

2. Does the implementation of QA/QC makes the construction procedure difficult?

1	2	3	4	5

3. Does the implementation of QA/QC makes the preparation of tendering/biding documents problematic?

1	2	3	4	5

4. In your opinion, does it true that by implementing QMS makes the company more preferable?

1	2	3	4	5

5. Does the implementation of QA/QC makes inspection work easier?

1	2	3	4	5

6. Does the implementation of QA/QC causes extra cost?

1	2	3	4	5

7. Does the implementation of QA/QC causes extra/unnecessary works (documentation, planning, etc.)?

1	2	3	4	5

8. Does the implementation of QA/QC causes delay or takes longer construction duration?

1	2	3	4	5

9. Does the implementation of QA/QC gives confidence in the presented products?

1	2	3	4	5

10. Does the implementation of QA/QC gives benefits to the company/organization?

1	2	3	4	5

SECTION C : THE IMPACT OF POOR QA/QC TO THE CONSTRUCTION PROJECT

For each statement below please write the numberin the box to indicate whether it is:

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

5 – STRONGLY AGREE

1. Time overrun
   - I. Construction Progress ☐
   - II. Materials delivery ☐
   - III. Testing ☐
   - IV. Market availability ☐
   - V. Client's decision ☐

2. Cost overrun
   - I. Workers salary ☐
   - II. Machineries rents ☐
   - III. Material costs ☐

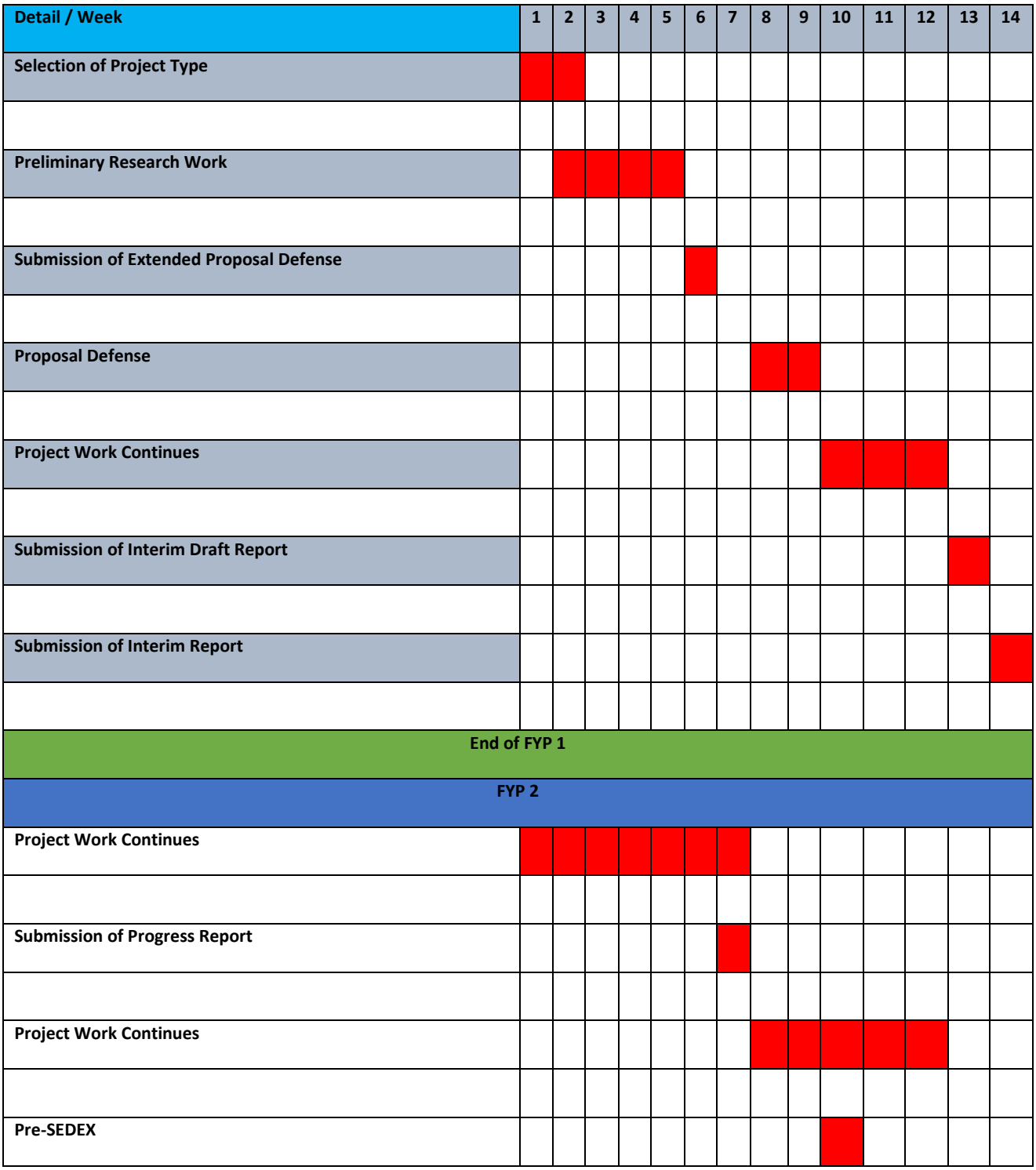
3. Disputes
   - I. Contract duration ☐
   - II. Materials ☐
   - III. Delivery ☐
   - IV. Construction cost ☐

4. Arbitration
   - I. Contract related ☐
   - II. Client related ☐
   - III. Contract relationship ☐

5. Litigation
   - I. Client related ☐
   - II. Labor related ☐
   - III. Contract relationship related ☐

THANK YOU VERY MUCH FOR YOUR TIME AND COOPERATION

Gantt Chart For Final Year Project Plan



Submission of Draft Final Report														
Submission of Technical Paper														
Submission of Dissertation (Soft Bound)														
Viva														
Submission of Project Dissertation (Hard Bound)														

Process

Suggested Milestone