

A CASE STUDY ON QUALITY MANAGEMENT SYSTEM  
IN CONSTRUCTION PROJECT

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A thesis submitted in fulfilment of the  
requirements for the award of the degree of  
Master of Science (Construction Management)

Faculty of Civil Engineering  
UNIVERSITI TEKNOLOGI MALAYSIA

NOVEMBER 2005

*Specially dedicated to my mother, father, family, wife and children  
who are always there for me*

### ***ACKNOWLEDGEMENT***

In preparing this thesis and as a part time student doing research, I owe much to my thesis supervisor, *Professor Madya Dr. Abdul Hakim Mohamed* for his encouragement, guidance, critics and patience without which I would have retreated earlier due to demanding office's works. I am indebted and fortunate to get valuable advice and help from many extra ordinarily capable people. Thanks to:

*Dr. L. Jawahar Nesan from Western Michigan University, USA;*

*Ir. Hanaffi Ayop from KLIA Consult Sdn. Bhd.;*

*Dr. Mohd Noor Sudin from Global ISO Quality Consultant Sdn. Bhd.;*

*Mr. Mohd Ali Ibrahim from UTM who guided me in preparing the research design;*

*and*

*all staffs of UTM and KLIA Berhad who in one way or another had provided me helps, information and cooperation.*

Special thanks to my wife who believed from the beginning that this research would get completed and helped arrange a home life that would allow for uninterrupted writing.

## ABSTRACT

Lack of research on project-based Quality Management System (QMS) and slight improvement observed in managing quality at project level by those ISO 9000 certified construction related companies instigated this research. The objectives were to investigate the main elements of project-based QMS and to develop a project-based QMS model that could be applied by all parties involved in construction project. The study commenced with the literature review which end-up with a set of propositions. The propositions then were scrutinised by the experts before they were explored during the case study. A single case study on the implementation of QMS at Kuala Lumpur International Airport (KLIA) project was conducted where data from multiple sources such as content analysis of the Project Quality Plan (PQP) and interview had been collected and analysed. The data from the multiple sources were triangulated and the main elements of project-based QMS were deduced. The main elements discovered for project-based QMS were management responsibility, quality planning, resources management, construction process control, inspection and testing, auditing, quality recording and data analysis and reporting. Using the IDEF0 modelling technique each element was converted into a context diagram. The result of a combination of all context diagrams formed a project-based QMS model for construction.

## ABSTRAK

Kurangnya kajian yang dijalankan terhadap Sistem Pengurusan Kualiti (SPK) di peringkat projek dan penambahbaikan yang kecil diperhatikan di dalam menguruskan kualiti di peringkat projek oleh syarikat-syarikat yang berkaitan dengan bidang pembinaan yang telah mendapat persijilan ISO 9000 telah mencetuskan kajian ini. Objektif-objektif kajian ini ialah untuk mengenalpasti elemen-elemen utama bagi SPK peringkat projek dan membangunkan satu model SPK peringkat projek yang boleh digunapakai oleh semua pihak yang terlibat di dalam projek pembinaan. Kajian ini dimulakan dengan kajian literatur di mana ianya telah menghasilkan satu set cadangan. Cadangan-cadangan tersebut kemudiannya dihalusi oleh beberapa orang pakar sebelum digunakan sebagai asas semasa kajian kes dijalankan. Satu kajian kes bagi pelaksanaan SPK di projek pembinaan Lapanganterbang Antarabangsa Kuala Lumpur (KLIA) telah dijalankan di mana segala data daripada pelbagai sumber seperti analisa kandungan Laporan Odit Dalaman dan Plan Kualiti Projek (PKP) dan temubual telah dikutip dan dianalisa. Data-data daripada pelbagai sumber ini dibuat perbandingan dan hasilnya ialah elemen-elemen utama untuk SPK peringkat projek. Elemen-elemen utama tersebut ialah tanggungjawab pengurusan, perancangan kualiti, pengurusan sumber, pengawalan proses pembinaan, pemeriksaan dan pengujian, pelaksanaan odit, penyimpanan rekod kualiti dan analisa data dan laporan. Dengan menggunakan teknik membuat model IDEF0 setiap elemen ditukarkan kepada 'context diagram'. Hasil kombinasi kesemua 'context diagram' ini membentuk satu model SPK peringkat projek untuk kerja-kerja pembinaan.

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**LIST OF ABBREVIATIONS**

BS	British Standard
BPR	Business Process Re-engineering
CI	Continuous Improvement
CPR	Construction Process Re-engineering
DCC	Document Control Centre
DFD	Data Flow Diagram
HR	Human Resources
ICAM	Integrated Computer-Aided Manufacturing
ICOMs	Inputs, Controls, Outputs and Mechanisms
IDEF0	ICAM Definition for process flow
ITP	Inspection and test plan
ISO	International Organization For Standards
KLIA	Kuala Lumpur International Airport
KLIAB	Kuala Lumpur International Airport Berhad
NCR	Non-conformance Report
PMC	Project Management Company
PQP	Project Quality Plan
QA	Quality Assurance
QC	Quality Control
QMS	Quality Management System
QMP	Quality Management principles
RFI	Request for Inspection
TQM	Total Quality Management

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Introduction**

This chapter comprises of seven sections that introduces the overall picture of the research. It discusses the background of the research subject, problem statement, research objectives, scope of the research, research methodology, significance of the research and organisation of the thesis.

#### **1.2 Background of the research**

Quality management system (QMS) is defined as “all activities of the overall management function that determine the quality policy, objectives and responsibilities, and implement them by means such as quality planning, quality control, quality assurance and quality improvement within the quality system” (MS ISO 8402, 1994). It is a general name for quality systems such as Total Quality Management (TQM), Kaizen, Business Process Reengineering (BPR) and the famous ISO 9000 quality standards. It is believed that if the objectives of a firm are well defined and subscribed by all employees, the responsibilities of the department



and the designation are clearly delineated and the procedures are well documented, it is likely that the products or services of the firm are “fit for purpose” and meeting the clients’ requirements. This is important as for a company to remain competitive it should meet the two essential factors i.e. to satisfy the client and to make profit. Evidences show that by adopting QMS, communications had been improved, mistakes, rework and wastage had been minimized, better control of sub-contractors and suppliers etc., thus increasing productivity, profit and market share and meeting the client requirements (Motwani et al, 1996).

The government of Malaysia has embarked the QMS programme in construction industry since 1994 through Construction Industry Development Board (CIDB). Since then the number of construction related companies certified with ISO 9000 had increased. However, the problem in the construction project especially related to quality such as building does not comply with specifications and sub-standard workmanships are still exist (CIDBM, 2000).

Construction is a project-based industry where temporary project organisation is constantly created and dissolved (Barret, 2000). At project level the major problem is to manage the interfacing activities and relationship among the construction parties (Stave, 1994). This major problem was still occurred even though the construction parties such as the Project Manager’s, Architect’s, Engineer’s and Contractor’s companies are ISO 9000 certified companies (Barret and Grower, 1998). The same situation happened although the requirement to implement the QMS is spelled out in the Conditions of Contract (Low and Goh, 1994).

The problem had actually initiated the research. One of the methods to minimise the problem is by implementing a project-based QMS. A project-based QMS is not for certification purpose but rather to synergise the construction team’s effort into achieving a congruent goal by developing an integrated Project Quality Plan (PQP).

It should be noted that the term “ISO 9000” used throughout the thesis is predominantly refers to ISO 9000:1994 version unless otherwise stated. The reason being is this version of ISO is the active version during the implementation of the case project and the beginning of the research i.e. 1999, notwithstanding the fact that in the year 2000 a new version of ISO i.e. ISO 9000:2000 was launched.

### **1.3 The problem statement**

A company-based QMS is common to construction related companies especially to those with the ISO 9000 certification. It is also quite extensively being studied as the literature survey showed that most of the QMS related researches (Davis, 1987; Eltigani and Djebarni, 1996; Al Nakeeb et al, 1998; Lo, 1998; Low et al, 1998; Netto et al, 1998; and Low and Henson, 1998) were focussed on the company-based QMS. However, research on the project-based QMS is lacking. If available, they were more on the development of the individual PQP of the construction team (Ciribini et al, 1994 and Gosselin, 1994). Therefore the aim of this study is to provide a project-based QMS model for the construction team.

The question now is how to develop a project-based QMS? Which QMS model to be based on? What are the main elements of project-based QMS? These have to be answered by considering the contractual relationship among the construction parties and the existing models of QMS and to look for a project that had implemented a full spectrum of QMS for a case study.

### **1.4 Objectives of the research**

The aim of the study is to provide a project-based QMS model for the construction team that has been explained under Section 1.3. The problem statement has led to the formulation of the objectives of the research i.e.:

- (a) To identify the main elements required for the implementation of project-based QMS; and
- (b) To develop an application model for project-based QMS.

### **1.5 Scope of the research**

The research will cover the followings:

- (a) The development of project-based QMS for construction project in Malaysia;
- (b) Only one project that had implemented the full range of QMS will be used as a case study subject. In other words, a single case study will be conducted;
- (c) The construction team describe in this research is referred to three main parties involved in the construction project i.e. the Project Manager (client's representative), the Consultants and the Contractors; and
- (d) The study will develop a theoretical framework only and will not cover the actual implementation and the post-implementation evaluation.

### **1.6 Research methodology**

To achieve the stated objectives, this research consisted the following four phases:

- (a) Literature review;
- (b) Preliminary investigation;
- (c) Case study of a selected project which had implemented QMS; and
- (d) Validation.

The four phases are now briefly explained.

### **1.6.1 Literature review**

The aim here was to develop the propositions for a project-based QMS. Accordingly the vast amounts of literature in QMS implementation in the construction industry were surveyed. Existing QMS models such as ISO 9000, TQM, BPR and Kaizen are also studied to select the most suitable for project environment. This phase also enabled the researcher to design appropriate strategies in collecting and analysing the data.

### **1.6.2 Preliminary investigation**

The research work then continued by fine-tuning the propositions. The experts' opinions on the propositions were sought. Meanwhile a preliminary investigation on the case project was carried out. This phase was important for familiarising with the researched case, observing the working environment and building relationship with the project personnel. The aim was to explore the possibilities of doing research on the subject and to refine the area of concerns. This phase had provided vital information for making a decision on the specific area to be studied in tandem with the accessibility and availability of the required information, taking into account with the limitation of the existing information. For instance, the research methods were limited to interview and content analysis of the quality records as the case project was physically completed and at the final stage of handing over.

### **1.6.3 Case study**

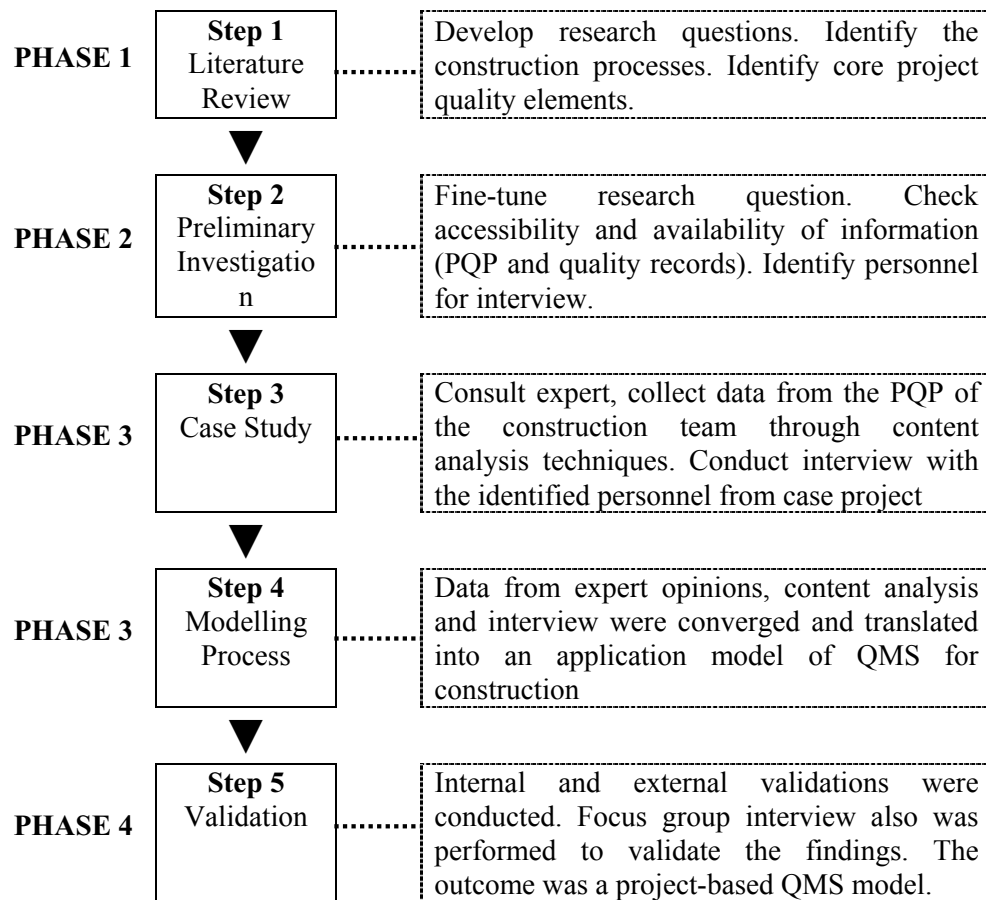
This phase was carried out due to the opportunity to access a mega project that had implemented QMS successfully. The project was Kuala Lumpur International Airport (KLIA). The case project was investigated through content

analysis of PQP and interviewing the key personnel of the project who were considered as expert in this field. The result was a demonstrable coincidence between the findings of the literature review and their occurrence in construction works. The key outcomes at this phase were a confirmed list of main elements in implementing project-based QMS and from the analysis of the qualitative data obtained and using IDEF0 modelling tools, a project-based QMS model applicable to the construction sector was developed.

#### **1.6.4 Validation**

This phase was aimed to validate the model through two types of tests i.e. internal validation and external validation. Internal validation was achieved by converging the findings of the three sources of evidences adopted for this study i.e. expert opinions, content analysis and interview. The pattern-matching technique was also adopted to strengthen the internal validity of the model. Focus group interview was performed to evaluate the external validity of the model. Having through all these tests the model was accepted to become a framework for the implementation of project-based QMS in construction.

The research methodology is as shown in Figure 1.1.



**Figure 1.1: Research methodology**

### **1.7 Significance of the research**

If a project-based QMS is implemented appropriately it will synergise the goals, energy, effort and understanding among the construction team. Consequently it will reduce the miscommunication, reworks and ensure the project to be completed within the agreed time, budget and specifications. However, currently available framework and guidelines on the project-based QMS are not properly evaluated and documented.

This research will discover the main elements of project-based QMS and will develop a project-based QMS model accordingly as a theoretical framework to assist the construction related companies especially the client's representative in initiating, developing and implementing a project-based QMS.

## **1.8 Organisation of the thesis**

This thesis is divided into six chapters i.e.:

Chapter 1 introduced the overall picture of the research such as the research background, problem statement, research objectives, scope of the research, research methodology, significance of the research and the organisation of the thesis.

Chapter 2 introduced the background of the development and principles of quality and quality management system (QMS) especially the ISO 9000. It also reviewed the construction process, the basic constructs of the ISO 9000 QMS and identified the fundamental elements that have to be addressed for the implementation of the QMS. The chapter then introduced the QMS at project level namely the Project Quality Plan (PQP). The problems of implementing the PQP in the construction industry were also highlighted. The responsibilities of each construction team according to the contract agreement are also discussed. The combination of these findings and the quality elements have led to the formulation of the propositions of the research.

Chapter 3 described the methods employed for the study and provided weight for the potential of the research to be conducted successfully. A number of data collections, analysis and modelling methods were discussed and eventually appropriate methods in conjunction with the conditions and environments surrounding the research were selected.

Chapter 4 reported the outcome of the analysis of the data gathered from the expert opinions. It also discussed the results of series of interview and content analysis of quality records kept at the KLIAB office in which the aim was to discover the actual condition of the implementation of the QMS in KLIA project. The main elements of project-based QMS identified in Chapter 2 became the referral points in conducting the investigation and each element was explored in order to identify its detail process especially in determining the input, output, mechanism and constraint during the execution of the activity.

Chapter 5 discussed the validation process of the model. It demonstrated the internal validation through data convergence and pattern matching technique. External validation through focus group interview was also presented in this chapter. The result was a valid application model together with the guidelines for implementing project-based QMS in construction.

Chapter 6 highlighted the main conclusions and several limitations of the research. It also recommended several points for further investigation.



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