TOWARDS ESTABLISHING A QUALITY MANAGEMENT SYSTEM BASED ON ISO 9000 REQUIREMENTS IN THE IRAQI MILITARY CONSTRUCTION ORGANIZATION

JAAFAR SADEQ ABDULHASAN

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TOWARDS ESTABLISHING A QUALITY MANAGEMENT SYSTEM BASED ON ISO 9000 REQUIREMENTS IN THE IRAQI MILITARY CONSTRUCTION ORGANIZATION

by

JAAFAR SADEQ ABDULHASAN

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DEDICATION

To

The pure and blessed lady who holds the distinction of being the Leader of the Women of all of the Worlds – from the first to the last – our Lady Fatima Al-Zahra the daughter of our great teacher Prophet Mohammad (Allah blessings and peace upon our Prophet Mohammad and his family), peace be upon her.

I dedicate this humble effort

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
AEQP-As	North Atlantic Treaty Organization Allied Quality Assurance Publications
ASCE	American Society of Civil Engineers
ASQC	American Society for Quality Control
AVE	Average Variance Extracted
CFA	Confirmatory factor analysis
CII	Construction Industry Institute
CSA-Z299	Canadian Standards Association
CTB	Counter Terrorism Bureau
DEF-STAN 05-21	U.K. Defence Standard 05-91/Issue 21
df	Degree of Freedom
DV	Dependent Variable
EC	European Community
EFA	Exploratory factor analysis
EQP-QA	Evaluating Quality Assurance process
EQP-QC	Evaluating Quality Control process
EQP-QI	Evaluating Quality Improvement process
EQPs	Evaluating fundamental Processes of Quality management system
IDMW	Iraqi Directorate of Military Works
IMOD	Iraqi Ministry of Defence
ISF	Iraqi Security Forces

Abbreviation	Meaning
ISO	International Organization for Standardization
ISO/TC 176	Technical Committee 176 of International Organization for Standardization
IV	Independent Variable
JNC	Major Non-conformance
KMO	Kaiser–Meyer–Olkin
MIL-Q-9858	The American Military Standard
ML	Maximum likelihood
MNSTC–I J7	Joint Engineering Directorate of Multinational Security Transition Command–Iraq
MOI	Iraqi Ministry of Interior
NATO	North Atlantic Treaty Organization
NNC	Minor Non-conformance
OFI	Opportunity for improvement
PCA	Principal Component Analysis
PDCA	Methodology of Plan, Do, Check and Act
PMBOK	Project Management Book of Knowledge
PMI	Project Management Institute
QA	Quality Assurance
QC	Quality Control
QCs	Quality Circles
QI	Quality Improvement
QMP-CF	Quality management principle -Customer Focus

Abbreviation	Meaning
QMP-CI	Quality management principle -Continual Improvement
QMP-FADM	Quality management principle - Factual approach to decision making
QMP-IP	Quality management principle -Involvement of People
QMP-L	Quality management principle -Leadership
QMP-MBRS	Quality management principle -Mutually Beneficial Supplier Relationships
QMP-PA	Quality management principle -Process Approach
QMPs	Quality management principles
QMP-SAM	System approach to Management principle
QMS	Quality Management System
QSC	Quality Steering Committee
RO	Research Objectives
SMEs	Small and Medium Enterprises
SPC	Statistical Process Control
SPSS	Statistical Package For The Social Sciences
SQC	Statically Quality Control
SQP	Strategic quality planning
TQM	Total Quality Management
U.K.	United Kingdom of Great Britain and Northern Ireland
U.S.	United States of America
VIF	Variance Inflation Factor

KE ARAH MEWUJUDKAN SISTEM PENGURUSAN KUALITI BERDASARKAN KEPERLUAN ISO 9000 DALAM ORGANISASI PEMBINAAN KETENTERAAN IRAQ

ABSTRAK

Terdapat kekurangan bukti yang menunjukkan pengaruh sistem pengurusan kualiti (QMS) ke atas prestasi syarikat dalam industri pembinaan dalam bidang ketenteraan. Kerahsiaan projek ketenteraan, hubungannya dengan keselamatan negara dan kecenderungan memusat dalam institusi ketenteraan telah menimbulkan ketiadaan pendedahan tentang penyelidikan yang berkaitan dalam domain awam. Kebanyakan kajian memfokuskan kepada makna penilaian dan pengukuran jurang aplikasi syarat standard QMS sebagaimana termaktub dalam Piawaian Organisasi Antarabangsa (Siri ISO 9000). Walaubagaimanapun, penyelidikan lampau telah mengabaikan dua peranan penting keperluan sistem tersebut iaitu prinsip pengurusan kualiti (QMPs) yang mengandungi asas rangka kerja peningkatan prestasi dan penilaian proses kualiti asas (EQPs). Kajian ini menentukan ciri asas semasa QMS dalam Organisasi Pembinaan Ketenteraan Iraq (IDMW). Mengukur kesan QMPs ke atas EQPs dapat membantu organisasi dalam merangka pelan bagi pembangunan QMS dan memastikan daya hidup sistem. Analisis jurang berdasarkan senarai semak berskala tujuh menunjukkan 30.66% jurang wujud berbanding dengan keperluan standard, yang menunjukkan QMP dan EQP tidak dilaksanakan dengan baik. Namun begitu item yang hilang (18 daripada 252) tidak mengganggu kesahan QMS. Tetapi IDMW mempunyai peluang untuk menambahbaik keadaan semasa. Data dipungut menggunakan kajian soal selidik berdasarkan persampelan mudah berstrata membabitkan kesemua cawangan IDMW. Pemboleh ubah tak bersandar (iaitu QMPs) mengandungi empat

dimensi, manakala pemboleh ubah bersandar (iaitu EQP) diwakili oleh tiga elemen. Keputusan kajian menunjukkan keperluan QMS dilaksanakan dalam kadar sederhana. Hanya dua QMPS (iaitu penglibatan orang dan pendekatan proses) mempunyai kaitan yang signifikan dan positif dengan EQPs. Tambahan pula, hasil menunjukkan bahawa sistem ketenteraan adalah teratur di mana ianya dapat mengurus hal ehwalnya dengan berkesan. Walaubagaimanapun, IDMW harus menggiatkan usaha untuk menyelesaikan item yang hilang, serta meningkatkan tindakbalas terhadap QMS berdasarkan keperluan standard QMS ISO 9001. Keputusan juga menyumbang kepada kewujudan model QMS dalam organisasi pembinaan dalam institusi pertahanan.

TOWARDS ESTABLISHING A QUALITY MANAGEMENT SYSTEM BASED ON ISO 9000 REQUIREMENTS IN THE IRAQI MILITARY CONSTRUCTION ORGANIZATION

ABSTRACT

There is a lack of evidence to show the effect of the quality management system (QMS) on the performance of companies in the construction industry in the military field. Confidentiality military project, its relationship with national security and military institutions of central tendency has resulted in the absence of disclosure of relevant research in the public domain. Most studies focus on the significance of the gap assessment and measurement applications QMS standard conditions as stipulated in the International Standards Organization (ISO 9000 series). However, past research has ignored two important needs of the system, namely the principles of quality management (QMPs) which contains the basic framework for performance improvement and evaluation of the quality of basic (QPS). This study determines the basic features of the QMS in Iraq Military Construction Organization (IDMW). Measuring the impact on QPS QMPs can help organizations to formulate a plan for the development of QMS and ensure the vitality of the system. The gap is based on a checklist of seven large-scale shows 30.66% compared with gaps exist standard requirements, which showed QMP and EQP is not done well. But the items are missing (18 of 252) do not interfere with the validity of the QMS. But DMW have the opportunity to improve the current situation. Data were collected using a questionnaire based on simple stratified sampling involves all branches DMW. Independent variables (i.e. QMPs) contains four dimensions, while the dependent variable (i.e. EQP) represented by three elements. The results show the need QMS implemented in

moderation. Only two QMPS (i.e. involvement and approach the process) has to do a significant and positive with QPS. Furthermore, the results show that the military system is organized in which they can effectively manage its affairs. However, IDMW must intensify efforts to resolve the items are missing, as well as improve response QMS based on standard requirements of ISO 9001. The results also contributed to the existence of the organization's QMS model construction in defence institutions.

CHAPTER 1

INTRODUCTION

1.1 Overview

This chapter provides an overview of the research background and problem statement, as well as presents the research questions, objectives, and significance and scope of the study. It also focuses on the definitions of the quality terms used in this study. Finally, this chapter outlines the organization of this study.

1.2 Research Background

The term "Total Quality Management" (TQM) was initially used in 1985 by the Naval Air Systems Command to describe the Japanese management style that focused on quality improvement (Bemowski, 1992). TQM is characterized by "less variability in the quality of the product and less waste" (Kerzner, 2013, p. 919). TQM has achieved success across a range of industries, from technology and food safety to agriculture, education, and healthcare. Such success was mainly achieved due to continuous quality improvement which is the fundamental principle of quality management. The PDCA (Plan–Do–Check–Act) model, which was introduced by Walter Shewhart in 1929 and popularized by W. Edwards Deming in the 1950s, pertains to "a flow diagram for learning, and for improvement of a product and a process". Deming advocated the use of PDCA as a continual quality improvement loop in analysing, measuring, and identifying the sources of variations from customer requirements and subsequently undertaking corrective action. PDCA is one approach toward TQM. The PDCA model provides a feedback mechanism for continual quality improvement (Deming, 1986).

Although TQM has been present in the military organization field since 1988, the research results related to the construction of military projects are not publicly disclosed (McCarthy & Eishennawy, 1991). In the military field, the current researcher concurred with Richard and Emhart's (1988) definition of TQM in the Department of Defence as "a strategy for continuously improving performance at every level, and in all areas of responsibility. It combines fundamental management techniques, existing improvement efforts, and specialized technical tools under a disciplined structure focused on continuously improving all processes. Improved performance is directed at satisfying such broad goals as cost, quality, schedule, and mission need and suitability. Increasing user satisfaction is the overriding objective" (J. S. Oakland & Morris, 2013, p. 1).

However, applying TQM in the military construction organization is highly complicated and inconsistent with the military methodology in certain cases. First, applying TQM is a common responsibility among senior management and employees of an organization. Second, TQM lacks specific goals. Quality management is deficient in a distinct path toward achieving certain goals. These reasons are apparently incompatible with the concept of chain of command and the pre-defined tasks in the military regime (Blomberg, Cotellesso, Sitzabee, & Thal, 2014; Radulescu, 2013; Winsor, 1996). Hence, the establishment of a paved system toward TQM [i.e., quality management system (QMS)] is promoted. Fulfilling the QMS requirement is the first step in the application of TQM in an organization (Quazi & Padibjo, 2006).

The origins of QMS can be traced back to the 1950s when the U.S. Department of Defence and the U.K. Ministry of Defence recognized the need for increased reliability in purchased products and reduced reliance on customer or purchaser

inspection as the major assurances of quality (Dale, Wiele, & Lwaarden, 2007). The military organization requires QMS to demonstrate that its processes are both operative and under control, and that procedures and systems are supervised effectively. The pressure to prove that systems and procedures are in place and functioning has induced the demand for quality assurance based on the development of QMS standards (Al-Khatib, 2008; Ilkay & Aslan, 2012; Sun, 1999; Tsiotras & Gotzamani, 1996). Al-Khatib defines QMS as "a set of co-ordinated activities to direct and control an organization in order to continually improve the effectiveness and efficiency of its performance" (Al-Khatib, 2008, p. 264). Moreover, the International Organization for Standardization (ISO) describes QMS as "a network of processes consisting of responsibilities, authorities, relationships, functions, plans, policies, procedures, practices, processes, and resources. It aims to satisfy quality management requirements and to ensure customer satisfaction with the quality of products or services" (ISO, 2005).

ISO is an independent, non-governmental membership organization and the largest developer of voluntary international standards in the world. ISO comprises 162 member countries that represent the national standards bodies around the world, with a Geneva, Switzerland-based Central Secretariat. International standards ensure the efficiency of operations and processes (ISO, 2015). ISO provides world-class specifications for products, services, and systems to guarantee their quality, safety, and efficiency. This organization is instrumental in facilitating international trade. ISO has over 20 500 International Standards covering almost all aspects of technology and business. All standards can be found in the ISO store (ISO, 2015). ISO international standards affect everyone, everywhere.

ISO has submitted four standards requirements for QMS, namely, ISO 9000, 9001, 9004, and 19011. These standards requirements are collectively known as the ISO 9000 family or ISO 9000 series. The ISO 9000 series is probably the most extensively implemented set of standards requirements in the world adopted by 250,000 construction companies in 163 countries (ISO, 2014). These standard requirements could be applied in any organization, whether for profitability, service, or advisory purposes. Moreover, the ISO 9000 family of international quality management standards and guidelines has earned a global reputation as a basis for establishing an effective and efficient QMS (Cao, 2010).

Applying ISO 9000 QMS in construction firms boosts corporate image, develops operational procedures, increases competitive power, output, and communication among employees of the firm, reduces material waste (Ofori, Gang, & Briffett, 2002), protects the international market shares, facilitates the inclusion of new projects, and provides competitive advantage (Ahmed, Aoieong, Tang, & Zheng, 2005; Yates & Aniftos, 1997).

A typical ISO 9000 series QMS consists of four levels that are depicted in a pyramid. Atop the pyramid is a single document that presents an overview of the entire system. The overview is followed by organizational policy statements. These policy statements are supported by descriptions of the principles to be employed in different management areas. The quality management principles (QMPs) that underlie QMS universal processes are quality assurance (QA), quality control (QC), and quality improvement (QI) (J M Juran & Godfrey, 2008), which are defined with flow charts. Flowcharts are hyperlinked to work instructions, standards, forms, templates, sample documents, and guidelines, among others. The Organizational size and complexity

determine the number of manuals containing work instructions or procedures (Rumane, 2011).

Rocha-Lona et al. (2013) concurred with Al-Mustafa (2001) regarding the suggestion to apply the PDCA model or Deming Cycle in establishing QMS. The PDCA stages are stationary phases in organizations that adopt the standard QMS ISO 9000 or those that intend to obtain the ISO certificate; however, the application of QMS depends on organizational size and operations, as well as the type of service or product provided (Hoyle, 2009).

1.3 Case Study

The focus of this study is on one organization, which is the Iraqi Directorate of Military Works (IDMW). According to Yin (2013), IDMW is considered as a case study. IDMW chiefly prepares the architectural and construction drawings, details, and technical specifications, which are required in the contract documents for the construction of infrastructure projects of the Iraqi Army. However, the implementation of projects by local or foreign companies is frequently under contract to regulate the relationship.

The justifications for the selection of IDMW as the case study are as follows.

1) Major duties are performed by IDMW to meet the requirements of the infrastructure projects of the Iraqi Army.
2) Abundant financial resources are allocated every year for infrastructure projects to enable quality management to adopt real dimensions.
3) A decision maker in the Iraqi Ministry of Defence (IMOD) agrees to conduct the study and cooperate fully with the researcher.

1.3.1 Iraqi Army Infrastructure

The Third Gulf War ended with victory for the coalition forces led by the United States. The civil governor from United States eventually ruled Iraq after a change in the regime. On May 23, 2003, the civil governor announced the disbandment of the Iraqi Army, which was later considered a huge mistake (Bremer, 2006). This decision engendered the destruction of nearly all of the infrastructures of IMOD. The deteriorating security situation prompted the restructuring of the Iraqi Army in 2004.

The Joint Engineering Directorate of Multinational Security Transition Command–Iraq (MNSTC–I J7) is responsible for constructing the facilities for the Iraqi Security Forces within IMOD, Iraqi Ministry of Interior (MOI), and Counter Terrorism Bureau. From 2003 to 2008, MNSTC–I J7 implemented more than 600 projects for IMOD and MOI at an estimated cost of more than US$5 billion (Ware, 2009).

1.3.2 IDMW after the Third Gulf War

IDMW underwent a bureaucratic organizational restructuring on April 12, 2005. In particular, IDMW was re-founded as a small directorate attached to the General Directorate of Infrastructure (cancellations) and charged with contractual responsibility until 2007.

The MNSTC–I J7 did not use to consult IDMW on projects involving construction plans for the Iraqi Army, which caused because it caused major problems for IMOD. The projects were built in the allocated IMOD sites. Although the projects entailed a vast investment, they did not fit the IMOD requirements or the technical specifications. Nevertheless, IDMW continued to coordinate with MNSTC–I J7 to

discuss the proposed projects and to participate in the studies, designs, and supervision of construction, which facilitated the process of receiving and delivering a number of projects.

IDMW considerably advanced after 2008, which resulted from the Directorate efforts of planning and funding important and large projects. These projects included building the self-sufficiency project of the Armed Forces at an estimated cost of US$336 million and the General Hospital projects of the Armed Forces (400 beds) at an estimated cost of US$118 million. Despite the specialized nature of these vital projects and the lack of experience of IDMW with such projects, IDMW has proven its strong capacity to plan and supervise the engineering in those projects. The level of construction quality in those projects is acceptable to the current circumstance but inappropriate for the level of permanent headquarters plan for the Iraqi Army.

The IMOD infrastructure is still in the preliminary steps. The permanent housing plan of the army has yet to be initiated. This significant and sensitive project should be undertaken according to a specific schedule. This issue requires the creation a reform plan to improve the existing QMS in IDMW, and thus contribute to the project.

1.3.3 Organizational Structure of IDMW

Ministerial Order No. 898 in the letter of The Secretariat General No. 17522 on September 11, 2012 stipulated the last adjustment in the structure of IDMW after the decision to restructure the Iraqi Army in 2004 during the research period. IDMW departments were classified according to their functions as follows: construction departments (responsible for implementing the Iraqi Army requirements), support

departments (concerned with staff matters, such as training and recruitment), and regional departments. Regional departments are dispersed around Iraq to undertake special duties in the region and function on behalf of construction departments in terms of supervising or testing the implementation works (see Figure 1.1).

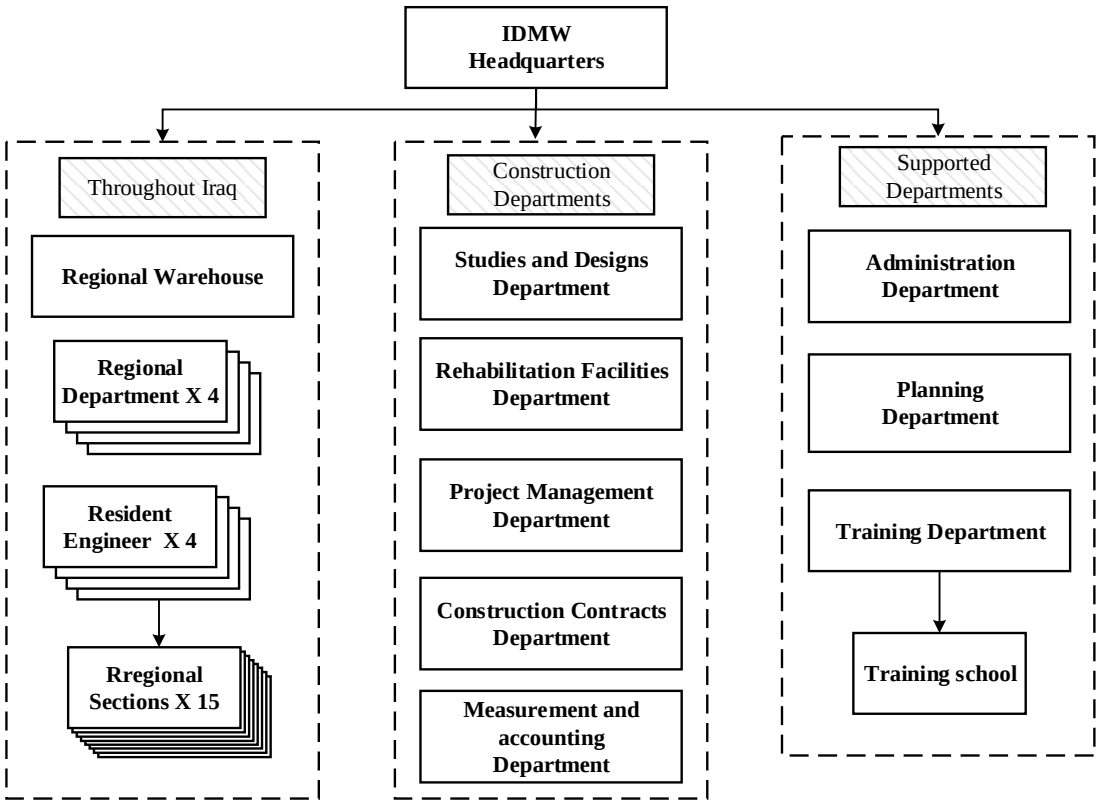

Figure 1.1 Organizational Structure of the Military Works Directorate.

The implementation of military construction projects involves four phases, namely, project planning, contract, supervision, and maintenance. Different departments within IDMW perform each phase. A construction contract is critically important. It consists of a number of documents and items that explain the manner of project implementation and the steps in contract implementation for project completion, including the various works, multiple specialties, and specific levels of existence that should be provided for the final product. The long-term implementation

of the construction contract requires contract documents that carefully define the responsibilities and obligations of each party. An important aspect focuses on the possibility of inevitable circumstances or situations that are not subject to the will of the parties to the contract during the execution.

1.3.4 QMS within IDMW

QMS is a network of processes consisting of responsibilities, authorities, relationships, functions, plans, policies, procedures, practices, processes, and resources. QMS aims to satisfy customers' requirements and other interested parties in order to ensure customers' satisfaction with the quality of products or services. IDMW lacks a special department or section that is responsible for QMS (see Figure 1.1). However, QMS is at the core of organizational aspects. For example, the Studies and Design Department and the Construction Contracts Department create a project quality plan involving quality assurance processes for ensuring a quality work output. Upon completion of the work output, the project manager and resident engineer inspect the projects based on the quality assurance plan to verify compliance with quality standards before accepting the completed works.

Similarly, the regional departments develop a quality control processes according to quality assurance plan for ensuring a quality work output. Upon completion of the work output, the Rehabilitation Facilities Department and Resident Section inspect the maintenance based on the quality control plan to verify compliance with quality standards before accepting the completed works. Meanwhile, the regional warehouse ensures the quality of construction materials stored until utilization.

The Administration Department, Training Department, and training school are responsible for personnel matters. They support all of the organizational staff members by providing the necessary training to upgrade their quality performance level.

The Measuring and Accounting Department handles the quality and cost elements. It arranges the financial affairs of the projects and the payment of contractors and accounts for fines and irregularities in works completed according to the reports of the resident engineer.

1.4 Problem Statement

The regulatory authorities in Iraq pointed out in their periodic reports several issues on the quality system of IDMW (Performance Report, 2013). For example, the performance report on June 25, 2013 for a particular project (i.e., building the self-sufficiency of the Armed Forces) indicated that the project budget was approximately US$336 million and the project was supposed to be completed at the end of 2010. However, on the date of the report, the total percentage of completion was 88% and the extended duration increased by 175% from the contract duration of the project. The cost also increased as additional works expanded by 4.11%. Finally, the report enumerated a long list of non-conformity works, which were not executed according to contract specifications.

The preceding example signifies the need for IDMW to establish a system that is aligned with the standard QMS. This system should enhance the efficiency of IDMW in running and managing the processes, responsibilities, authorities, relationships, functions, plans, policies, procedures, practices, processes, and resources on construction projects. Regardless of the approach adopted toward the

quality management maturity in the military construction organization, a business may need to demonstrate to the regulatory authorities that its processes are both effective and under control and that procedures and systems are supervised efficiently. In addition, an organization should identify the gap between the current QMS and the QMS standard because QMS requirements define a uniform meaning and agree with the principles and processes. QMS requirements benefit businesses and facilitate the assessment of their compatibility in an administrative perspective on a global level. This aspect has prompted numerous military construction organizations to adopt QMS similar to the standard QMS of ISO 9000, such as the American Military Standard MIL-Q-9858 (a), the North Atlantic Treaty Organization Allied Quality Assurance Publications, and the Canadian Standards Association (Dale et al., 2007).

Only a few studies have analysed the establishment of QMS according to the PDCA model or the number of steps within the PDCA model in the military construction organization and military procurement in the public domain (Rocha-Lona et al., 2013). The military construction organization is non-profit and does not seek to obtain the ISO 9001 certification. It is also a public organization because the privacy policy of military projects is inconsistent with the awarding of ISO requirements. Hence, applying QMS may seem an excessive cost or an increase in expenditure of public funds at first glance, and may induce difficulties in applying QMS based on ISO 9001 in the construction industry (Bubshait & Al-Atiq, 1999; Ofori et al., 2002).

Numerous studies have examined the QMS standard of ISO 9000, but the majority have focused on the process of evaluating and measuring the gap between the ISO 9001 requirements and the actual QMS within different industrial sectors as the basis for evaluating the effectiveness of QMS (Shahrir Abdullah et al., 2011; Llach,

Marimon, & Bernardo, 2011; Sumaedi & Bakti, 2011). These studies have suggested filling the gap through the continuous improvement cycles of QMS requirements. They neglected to focus on the effects of a fundamental framework or beliefs in leading and operating an organization aimed at continually improving its performance in the long term by addressing stakeholder needs or QMPs.

The continuous improvement cycles should be included in QMPs to avoid diverting the path from QMS toward the quality documentation system (Ahmed et al., 2005; Ofori et al., 2002; Yates & Aniftos, 1997). This inclusion requires an investigation of the effectiveness of QMPs (ISO, 2012).

In addition, the standard requirements are not limited to a certain part of the organization, but involve all of its sections; quality processes are responsible for achieving the standard requirements (Biazzo & Bernardi, 2003). Each process has a constant purpose in the quality policy of an organization. The QMS universal processes are QA, QC, and QI (J M Juran & Godfrey, 2008). Therefore, the QMS universal processes are evaluated (EQPs) to measure the emergent change.

The preceding discussion raises several issues. That is, (1) whether the efficiency of EQPs fits inversely with the application gap of QMS standard requirements; (2) QMPs constitute the fundamental framework for continually improving organizational performance; thus, how QMPs enhance the application QMS standard requirements should be determined; (3) EQPs and QMPs aim to reduce the application gap and enhance the application of QMS standard requirements; hence, the effects of QMPs on EQPs should be ascertained. At the same time, the QMP principles that chiefly influence the efficiency of QMS in IDMW should be identified.

1.5 Research Objectives

This study aims to establish a QMS for the military construction organization in Iraq based on the ISO 9000 standards family according to the PDCA model. Specifically, it attempts to define the application reality of each component of QMS and explore the effects of QMPs on the requirements and EQPs. Thus, the objectives of this study are as follows.

1) To identify the gap between the existing QMS of the military construction organization in Iraq and the QMS standard of ISO 9001;
2) To separately determine the effectiveness of each QMPs and EQPs within the military construction organization in Iraq based on the gap in the existing QMS; and
3) To investigate the effects of QMPs on EQPs in the military construction organization in Iraq.

1.6 Research Questions

Specifically, this study seeks to answer the following research questions:

1) What is the gap between the existing QMS of the military construction organization in Iraq with the QMS standard of ISO 9001?
2) How to determine the effectiveness of each QMPs and EQPs separately of the military construction organization in Iraq based on the gap in the existing QMS?
3) How do QMPs affect EQPs in the military construction organization in Iraq?

1.7 Significance of the Study

This research focuses on a vital subject that has not been analysed in previous studies in the public domain, and clarifies the process of addressing the needs of the military organization. The military construction organization is required to demonstrate to regulatory authorities or stakeholders that its processes are both effective and under control, and that its procedures and systems are well supervised according to international standards. This requirement can be fulfilled only through the establishment of a QMS that is in accordance with international standards on the one hand, and with the military environment, on the other hand. Fortunately, the military environment has opportunities to overcome the risks of a TQM initiative. Establishing QMS in military organizations raises several concerns because the bureaucracy of military organizations tends to grow, spend lavishly, impose elaborate procedures, and diffuse accountability to the point where clear responsibilities are lacking.

Research on the effect of QMS on military construction or the influence of military construction projects on procurement is limited because of the sensitivity of buildings and infrastructures. Even if such studies are conducted, they are typically unavailable in the public domain. Moreover, access is often limited. The few studies on military procurement have focused on cost (Blomberg et al., 2014), risk (Stuban, Mazzuchi, & Sarkani, 2011), partnering (Glagola & Sheedy, 2002), and similar factors. Various studies have addressed the improvement of quality in the construction industry by employing two major techniques, namely, management techniques such as TQM (Harrington, Voehl, & Wiggin, 2012; Saeed., Awad Sad Hasan, Mohammed, Saeed, & Hasan, 2012) and ISO 9000 (Shardy Abdullah, Abdul Razak, Hanizun Hanafi, & Jaafar, 2013; Chini & Valdez, 2003; Pheng & Abeyegoonasekera, 2001), and statistical techniques such as cost of quality (Abbasnejad, 2013; Love & Li, 2000) and the Six Sigma approach (Brue, 2002; Corporation, 2004; Lee, Su, & Yang, 2013; Marves, 2000; Tennant, 2001; Yang, 2005).

1.8 Definitions of Quality Terms

Table 1.1 provides several salient terms that are directly applied to this study with explanations adopted from the ISO 9000 (the fundamentals and vocabulary of QMS). Several precise definitions are available in ISO 9000:2005.

Table 1.1 Definitions of Quality Terms.

Term	Denotation
Quality	The "degree to which a set of inherent characteristics fulfils requirements" (Clause 3.1.1 of ISO 9000:2005).
Management System	"System to establish policy and objectives and to achieve those objectives" (Clause 2.2.3 of ISO 9000:2005). A management system of an organization can include different management systems, such as a quality management system, a financial management system or an environmental management system.
Quality management	"Coordinated activities to direct and control an organization with regard to quality" (Clause 8.2.3 of ISO 9000:2005). Direction and control with regard to quality generally include establishment of the quality policy and quality objectives , quality planning , quality control , quality assurance and quality improvement
Quality Management System	A management system that directs and controls an organization with regard to quality (Clause 3.2.3 of ISO 9000:2005). Activities generally include the following: a) establishment of a quality policy and quality objectives; b) quality planning; c) quality control; d) quality assurance; and e) quality improvement.
universal process of managing quality	The Quality Assurance, Quality Control, and Quality Improvement processes are sometime called "Juran's Trilogy". They all work together to help leadership to realize the full benefits of Quality Management system of an organization.
Quality Assurance	Quality assurance is also a part of quality management, but it is focused on providing confidence that quality requirements will be fulfilled (Clause 3.2.11 of ISO 9000:2005).
Quality Control	Quality control is a part of quality management focused on fulfilling quality requirements (Clause 3.2.10 of ISO 9000:2005).
Quality improvement	Quality improvement is another part of quality management that is focused on increasing the ability to fulfil quality requirements (Clause 3.2.12 of ISO 9000:2005). It is not concerned with correcting errors, but concerned with doing things better to improve system efficiency and effectiveness.
Quality Management Principles	A framework to guide senior management of organizations towards improved performance (Clause 2.0 of ISO 9000:2005)
Quality manual	"A document for specifying the QMS of an organization".(Clause 3.7.4 of ISO 9000:2005)
Quality policy	"Overall intentions and direction of an organization related to quality as formally expressed by top management" (Clause 3.2.4 of ISO 9000:2005). Generally the quality policy is consistent with the overall policy of the organization and provides a framework for the setting of quality objectives. The Eight Quality management principles can form a basis for the establishment of a quality policy.

- *Source: (ISO 9000: 2005)*

1.9 Research Scope

The population size of this study was obtained from the data of the Administration and Training Departments of IDMW regarding the last adjustment in the organizational structure of IDMW during the research period (i.e., September 9, 2012 to March 16, 2015). The population in this study represented the technical staff of IDMW throughout Iraq, including the Kurdistan region, where Military Works Directorate projects and mission exist.

Moreover, the study was conducted based on ISO 9001:2008, particularly the fourth edition of ISO 9001. This edition remains valid and precedes the issuance of the fifth edition ISO 9001:2015 at the end of 2015.

1.10 Organization of the Study

The researcher attempts to embrace all of the aspects of improving QMS and uses IDMW in IMOD as the case study to demonstrate the process of enhancing EQPs through the development of QMPs. This study is organized into several chapters, as presented in Figure 1.2.

Chapter 1 is an introduction that defines the problem statement, the research questions, the importance and objectives of the study, the research sample and selection justifications of the organization under study, and the scope of the study.

Chapter 2 is a literature review on the definitions of quality in the construction industry. It also explains the reasons for adopting a military construction organization for QMS. Moreover, this chapter presents the proposed 10 steps for establishing a QMS within a military construction organization.

Chapter 3 describes the methodology used in the study. It also discusses the conceptual framework, research hypothesis, research variables, and research design of the study, including measures, questionnaire design (survey instrument), units of analysis, sampling, and pilot testing. This chapter likewise presents the survey instrument in detail with relevant reference to the literature.

Chapter 4 presents the results of the study, the application standard requirements and evaluation of both QMPs and EQPs in a military organization, and the relationship between QMPs and EQPs. The constructs are validated through research findings and factor assessment, leading to an empirical analysis of theoretical models.

Finally, Chapter 5 provides the conclusions and recommendations for improving QMS in a military construction organization, as well as suggested directions for future research.

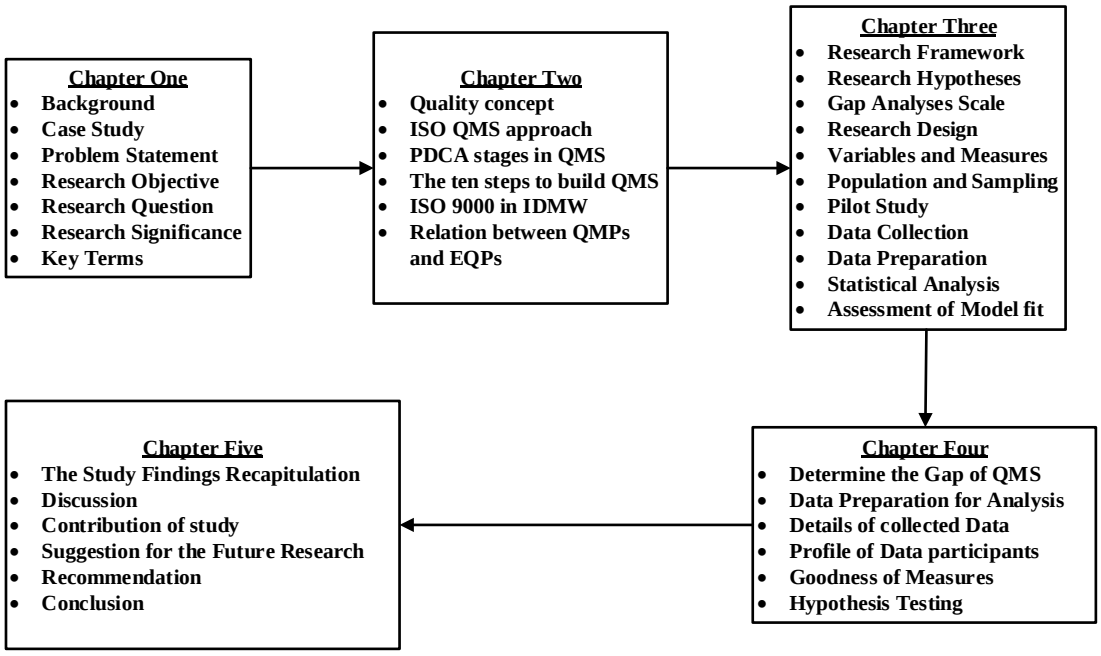

Figure 1.2 Summary of the Research Structure

1.11 Summary

This chapter presented an overview of the research background and problem statement, as well as the research questions, objectives, and significance and scope of the study. It also provided the definitions of the quality terms used in this study. Finally, it discussed the background of the case study of this research, the significance of selecting the case study, and the organization of the study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter explains the concept of quality in the construction industry. It also provides the reasons for selecting a military construction organization as a case study for quality management systems (QMS), given that such a firm is a non-profit organization that does not seek to obtain the ISO certificate. It also presents the four stages in the proposed 10 steps in establishing QMS within a military construction organization.

2.2 Concept of Quality in the Construction Industry

The definitions of quality are typically summarized under the terms developed by contributors to the quality movement. The philosophies, methods and tools of these contributors, who are referred to as 'quality gurus', have been confirmed to be beneficial in quality practices. The quality gurus' definitions of quality are as follows.

1) Philip B. Crosby: Quality denotes conformance to requirements, and not 'goodness' or 'elegance' (Crosby, 1989).
2) W. Edwards Deming: Quality should be designed into both the product and the process (Deming, 1986).
3) Armand V. Feigenbaum: Quality is best for customer use and selling price (Feigenbaum, 1991).

4) Kaoru Ishikawa: Quality refers to the product as well as after-sales services, quality of management, the organization itself and humans (Kaoru. Ishikawa, 1990).

5) Joseph M. Juran: Quality is fitness for use (J M Juran & Godfrey, 2008).

6) John S. Oakland: Quality signifies meeting customer requirements (Oakland, 2014).

The concept of quality in the construction industry is even more difficult to define. A product of the construction industry is chiefly not a repetitive unit or simply a unique element of utilizing specific functions (Sears, Sears, Clough, Rounds, & Segner, 2015). The construction cost and time of delivery are also important attributes of quality (Chung, 1999). Institutions in the construction industry have adopted more specific definitions of quality as follows.

1) The Construction Industry Institute refers to quality as 'customer satisfaction'(CII, 1989).

2) The American Society for Quality Control defines quality as 'the totality of factors and characteristics of a product or service that bears on its ability to satisfy given need' (ASQC, 1978).

3) The American Society of Civil Engineers provides the following definition of quality in construction projects:

'The fulfilment of project responsibilities in the delivery of products and services in a manner that meets or exceeds the stated requirements and expectations of the owner, design professional, and constructor. Responsibilities refer to the tasks that a participant is expected by contractual agreement and applicable laws and licensing requirements, codes, prevailing industry standards, and regulatory guidelines.

Requirements are what a team member expects or needs to receive during and after his or her participation in a project' (ASCE, 1988, p. xv).

The management of quality in the construction industry is an area of specialisation that has been growing over the past three to four decades. It embraces aspects of the project and company activities that are often viewed as remote from the physical product. Figure 2.1 shows various concepts that are considered to influence the quality of the product and are associated with quality in construction.

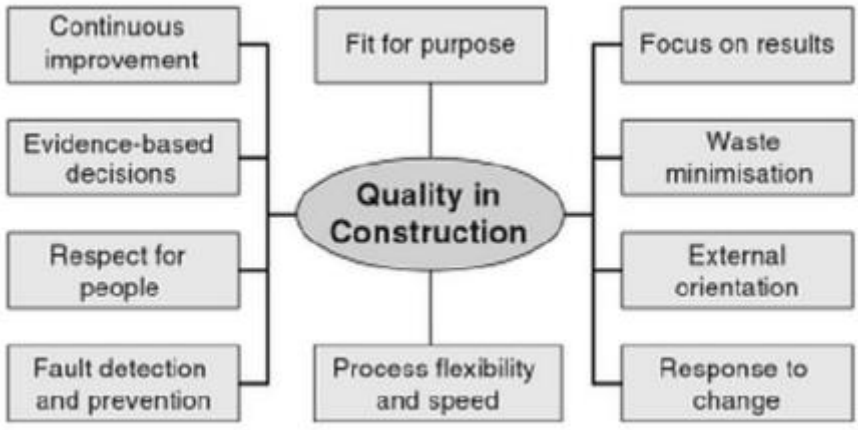

Figure 2.1 Scope of Quality in Construction.

- *Source:* (Harris, McCaffer, & Klakegg, 2013).

The various areas that contribute to quality in construction reflect the product features, production and organizational processes, as well as comprehensive company and industry or business issues (see Figure 2.1). In particular, the management of quality in construction has been embracing considerations that increasingly address pre-production processes and organization or industry issues. For example, an organization's quality status is viewed not merely in isolation, but increasingly from the perspective of industry-wide standards and against that of its competitors. This

study concurs with Rumane (2011) regarding the definition of quality in a construction project. Construction project quality refers to the fulfilment of the needs of the owner according to the defined scope of work within a certain budget and a specified schedule.

2.3 Quality Management Systems (QMS) Approach

QMS can be expressed as the organizational structure, procedures, processes and resources required for implementing quality management. Early systems emphasized the predictable outcomes of an industrial product production line using simple statistics and Convenience sampling. By the 20th century, labour inputs were typically the most costly inputs in most industrialized societies. Thus, focus shifted to team cooperation and dynamics, particularly the early signalling of problems via a continuous improvement cycle. In the 21st century, QMS has tended to converge with sustainability and transparency initiatives because both investor and customer satisfaction and perceived quality are increasingly linked with these factors (Dale et al., 2007).

QMS can be defined as '[a] set of co-ordinated activities to direct and control an organization in order to continually improve the effectiveness and efficiency of its performance' (Al-Khatib, 2008, p. 264). Moreover, ISO describes QMS as 'Coordinated activities that directs and controls an organization with regard to quality' (Clause 3.2.3 of ISO 9000:2005). Activities generally include the following: a) establishment of a quality policy and quality objectives; b) quality planning; c) quality control; d) quality assurance; and e) quality improvement (ISO, 2005).

These coordinated activities are concerned with and influenced by the effectiveness and efficiency of the entire QMS because the isolation and individual study of each activity in detail will not necessarily induce an understanding of the system as a whole. The major thrust of QMS is defining the processes, which will spur the production of quality products and services, rather than detecting defective products or services after they have been produced (Garvin, 2012). A major purpose and simultaneously a benefit of QMS is documentation. Documentation provides a clear framework of organizational operations. It also establishes the consistency of processes, enhances the understanding of QMS and provides evidence for achieving objectives and goals. Moreover, the complete documentation of QMS ensures that the following important requirements are fulfilled:

1) Customer requirements refer to the confidence in the capacity of the organization to consistently deliver the desired product and service, and thus satisfy needs and expectations (Olander, 2007).
2) Organizational requirements consider internal and external demands at an optimum cost and the efficient use of available resources, such as materials (Formoso & Revelo, 1999), human resources (El-dash, 2007), technology (Dogra, Sharma, Sachdeva, & Dureja, 2011) and information. These requirements can only be fully met if objective evidence is provided in the form of data (Falge, Otto, & Osterle, 2012) that support the system activities of the supplier to the customer.

QMS enables an organization to achieve goals and objectives in its policy and strategy. It provides consistency and satisfaction in terms of methods, materials, equipment etc. Furthermore, QMS interacts with all of the activities of the