

**T.C.  
ISTANBUL GEDİK UNIVERSITY  
INSTITUTE OF GRADUATE STUDIES**



**PROJECT MANAGEMENT AND IT'S EFFECT ON QUALITY CONTROL  
(A QUALITATIVE STUDY ON CONSTRUCTION PROJECTS IN IRAQ)**

**MASTER'S THESIS**

**Mohammed Ammar Adnan Al-SHAMMARI**

**Engineering Management Master in English Program**

**JULY 2021**

**T.C.  
ISTANBUL GEDİK UNIVERSITY  
INSTITUTE OF GRADUATE STUDIES**



**PROJECT MANAGEMENT AND IT'S EFFECT ON QUALITY CONTROL  
(A QUALITATIVE STUDY ON CONSTRUCTION PROJECTS IN IRAQ)**

**MASTER'S THESIS**

**Mohammed Ammar Adnan Al-SHAMMARI  
(191281006)**

**Engineering Management Master in English Program**

**Thesis Supervisors: Prof. Dr. Güzde ULUTAGAY**

**JULY 2021**



**T.C.**  
**İSTANBUL GEDİK ÜNİVERSİTESİ**  
**LİSANSÜSTÜ EĞİTİM ENSTİTÜSÜ MÜDÜRLÜĞÜ**

**Yüksek Lisans Tez Onay Belgesi**

Enstitümüz, Engineering Management Department İngilizce Tezli Yüksek Lisans Programı (191281006) numaralı öğrencisi Mohammed Ammar Adnan AL-SHAMMARI'nin "Project Management and It's Effect on Quality Control (A Qualitative Study on Construction Projects in Iraq)" adlı tez çalışması Enstitümüz Yönetim Kurulunun 13.07.2021 tarihinde oluşturulan jüri tarafından *Oy Birliği* ile Yüksek Lisans tezi olarak *Kabul* edilmiştir.

**Öğretim Üyesi Adı Soyadı**

**Tez Savunma Tarihi:** 13/07/2021

**1) Tez Danışmanı:** Prof. Dr. Gözde ULUTUGAY

**2) Jüri Üyesi:** Dr. Öğr. Üyesi Ozan ATEŞ

**3) Jüri Üyesi:** Dr. Öğr. Üyesi Senem VAHAPLAR

## **DECLARATION**

I, Mohammed Ammar Adnan AL-SHAMMARI, do hereby declare that this thesis titled as “Artificial Intelligence Utilization in Production Quality Management: Piping Fabrication” is original work done by me for the award of the masters degree in the faculty of Engineering Management. I also declare that this thesis or any part of it has not been submitted and presented for any other degree or research paper in any other university or institution. (13/07/2021)

Mohammed Ammar Adnan AL-SHAMMARI



## **DEDICATION**

I want to dedicate this thesis to Allah Almighty, my creator for His guidance and support and for giving me the strength and the health to complete this research.

This thesis is also dedicated to my family, especially my dear mother Malath Faeq, who was and still is the first supporter and encouragement after Allah Almighty.

Finally, I would like to dedicate this research to my friends, especially my friend Ali Khaled, who stood up for me and gave me support to finish this research.

## **PREFACE**

All thanks be to Allah Almighty for His Guidance that allowed me to complete my thesis. To those who drove me to complete my Masters' Thesis, I salute you all. My professors, and my family, and my friends, who have been a constant source of support during all my endeavors, their inspiration is what made me not give up during this arduous period.

To Prof. Dr. Gözde ULUTAGAY, for her constant support and encouragement, thank you for your constant inspiration and willingness to help no matter how many times I would ask you for your assistance. I could not have asked for a better supervisor than you. Thank you.

July 2021

Mohammed Ammar Adnan AL-SHAMMARI

---

## TABLE OF CONTENTS

	<u>Page</u>
<b>PREFACE</b> .....	<b>v</b>
<b>TABLE OF CONTENTS</b> .....	<b>vi</b>
<b>LIST OF ABBREVIATIONS</b> .....	<b>viii</b>
<b>LIST OF TABLES</b> .....	<b>ix</b>
<b>LIST OF FIGURES</b> .....	<b>x</b>
<b>ABSTRACT</b> .....	<b>xi</b>
<b>ÖZET</b> .....	<b>xii</b>
<b>1. INTRODUCTION</b> .....	<b>1</b>
1.1 General .....	1
1.2 Construction Management .....	3
1.2.1 Human control .....	3
1.2.2 Quality control standards .....	4
1.2.3 Selection of optimal process and materials .....	4
1.2.4 Other parameters influencing the quality management system .....	4
1.3 Quality Control in Construction .....	5
1.4 Objective .....	5
1.5 Questionnaire Format .....	6
1.6 Scope of Thesis .....	6
<b>2. LITERATURE REVIEW</b> .....	<b>7</b>
2.1 General .....	7
2.2 The Quality Process in a Construction Project.....	8
2.3 Design.....	8
2.3.1 Customer requirements .....	9
2.3.2 Social requirements .....	9
2.4 Production .....	9
2.4.1 Control plan .....	9
2.4.2 Industry rules .....	10
2.4.3 Self-checks.....	10
2.4.4 Testing .....	10
2.4.1.1 Final documentation.....	11
2.4.1.2 Inspections.....	11
2.4.1.3 Final message .....	11
2.5 Quality Management During Production .....	11
2.5.1 The importance of leadership for quality.....	12
2.5.2 Total Quality Management .....	13
2.6 Implementation.....	14
2.7 Standardization.....	15
2.8 ISO 9001.....	16
2.9 Digitization.....	17
<b>3. MATERIAL AND DATA COLLECTION</b> .....	<b>20</b>
3.1 General .....	20

3.2 Preliminary Study .....	20
3.3 Semi-structured Interview Method.....	20
3.4 Data .....	21
3.5 Selection .....	21
3.6 Observations .....	22
<b>4. RESULTS .....</b>	<b>23</b>
4.1 General .....	23
4.2 The Interview Respondents .....	23
4.3 The Data Collect from Questionnaire Survey .....	26
4.3.1 Common quality control practices in construction sector questions .....	28
4.3.2 Experience of respondents in quality management system questions .....	34
4.4 The Concept of Quality .....	41
4.5 Requirements .....	42
4.6 Quality Management .....	42
4.7 Standardization .....	44
4.8 Digitization .....	45
4.9 Development .....	45
4.9.1 Frame work develop for quality control in project construction .....	46
<b>5. ANALYSIS .....</b>	<b>48</b>
5.1 General .....	48
5.2 Concept of Quality .....	48
5.3 Requirements .....	48
5.4 Quality Management .....	48
5.5 Standardization .....	50
5.6 Digitization .....	50
5.6 Development .....	51
<b>6. DISCUSSION .....</b>	<b>52</b>
6.1 General .....	52
6.2 Theory and Method Discussion.....	52
6.3 Results Discussion.....	53
<b>7. CONCLUSIONS .....</b>	<b>56</b>
7.1 General .....	56
7.2 Development Opportunities .....	56
7.2.1 Standardization .....	56
7.2.2 Inspections at an early stage .....	56
7.2.3 Leadership.....	57
7.2.4 Digital tools .....	57
7.3 Suggestions for Further Studies .....	57
<b>REFERANCES.....</b>	<b>59</b>
<b>APPENDIX .....</b>	<b>61</b>
<b>RESMUE.....</b>	<b>67</b>

## **LIST OF ABBREVIATIONS**

BFS	: Business and Financial Services
BIM	: Building Information Modeling
CM	: Construction Management
ILO	: International Labor Organization
ISO	: International Organization for Standardization
PBL	: Problem-Based Learning
PDS	: Project Delivery System
PM	: project Manager
PW	: Professional Worker
QC	: Quality Control
QEM	: Quality and Environmental Manager
QMS	: Quality Management Systems
TQM	: Total Quality Management

## LIST OF TABLES

	<u>Page</u>
<b>Table 4.1:</b> The Project Managers Who Participate in the Interview and Some of Their Personal Information .....	23
<b>Table 4.2:</b> Quality Control Result from Project Manager’s Questioner Format.....	25
<b>Table 4.3:</b> Distribution of the Questionnaire Survey Sample According to the Personal Variables.....	26
<b>Table 4.4:</b> Frame Work for the Quality Control.....	46



## LIST OF FIGURES

	<u>Page</u>
<b>Figure 2.1:</b> Illustration of The Construction Process .....	8
<b>Figure 2.2:</b> (a) The Good Leadership Culture, (b) The Bad Leadership Culture.....	12
<b>Figure 2.3:</b> Bergman and Klefsjö's (2018) Translation of Deming's Improvement Cycle. ....	15
<b>Figure 2.4:</b> The Flow of Information with Regard to Quality in Production Using BIM .....	18
<b>Figure 4.1:</b> Graphical Representation of a Project Manager's Professional Experience .....	24
<b>Figure 4.2:</b> Graphical Result of Project Manager Questioners' Format .....	26
<b>Figure 4.3:</b> Qualification Level .....	27
<b>Figure 4.4:</b> Overall Years of Experience .....	28

## **PROJECT MANAGEMENT AND IT'S EFFECT ON QUALITY CONTROL (A QUALITATIVE STUDY ON CONSTRUCTION PROJECTS IN IRAQ)**

### **ABSTRACT**

The construction industry is sometimes associated with poor quality. By using quality management tools in production, the right quality of the end product must be provided. The report studies the quality work at some contracting companies in Iraq to investigate whether something can be done differently to increase the quality of the end product. By conducting a qualitative interview study with twenty-six project managers at some different companies located in different cities in Iraq. In addition to a questionnaire survey to see if the quality of construction projects is acceptable and to obtain a near-comprehensive result. It is analyzed what is the working method works well and what can be improved.

The results show that much of the current quality work method works well, but that there are several factors that play a significant role in how the quality of the end product will be. For example, using inspectors at an early stage facilitates the work of verifying the requirements and achieving a high-quality end product. It appears that the controls of the work performed can be performed by the professional workers, which can increase the motivation to perform a work of high quality.

**Keywords:** *Digitization, Self-checks, Quality management, Quality assurance, Requirements, Total quality management, TQM*

## PROJE YÖNETİMİ VE KALİTE KONTROL ÜZERİNE ETKİSİ (IRAK'TA İNŞAAT PROJELERİ ÜZERİNE KALİTATİF BİR ÇALIŞMA)

### ÖZET

İnşaat sektörü bazen düşük kalite ile ilişkilendirilmektedir. Üretimde kalite yönetim araçları kullanılarak nihai ürünün doğru kalitede olması sağlanmalıdır. Hazırladığımız bu çalışma, nihai ürünün kalitesini artırmak için farklı bir şeyler yapılıp yapılamayacağını araştırmak için Irak'taki bazı müteahhitlik şirketlerindeki kalite çalışmalarını incelemektedir. Irak'ın farklı şehirlerinde bulunan birbirinden farklı şirketlerden yirmi altı proje yöneticisi ile nitel bir görüşme çalışması yapılmıştır. Bunun yanında inşaat projelerinin kalitesinin kabul edilebilir olup olmadığını görmek ve neredeyse kapsamlı bir sonuç elde etmek için bir anket çalışmasıyla da çalışma desteklenmeye çalışılmıştır.

Elde edilen sonuçlara göre, mevcut kaliteli çalışma yönteminin çoğunun iyi çalıştığını, ancak nihai ürünün kalitesinin nasıl olacağı konusunda önemli bir rol oynayan birkaç faktörün bulunduğu ortaya çıkartılmaktadır. Örneğin, denetçilerin erken bir aşamada kullanılması, gereksinimlerin doğrulanması ve yüksek kaliteli bir nihai ürün elde edilmesi çalışmalarını kolaylaştırır. Yapılan işin kontrollerinin profesyonel çalışanlar tarafından yapılabileceği ve bu da kaliteli bir iş yapma motivasyonunu artırabileceği görülmektedir.

**Anahtar Kelimeler:** *Sayısallaştırma, Öz kontrol, Kalite yönetimi, Kalite güvencesi, Gereksinimler, Toplam kalite yönetimi, TQM*

## **1. INTRODUCTION**

### **1.1 General**

Many industries, especially the engineering construction industry, have in recent years improved their efficiency logistics processes, which have resulted in safer deliveries, shorter lead times and less warehousing. However, this development has not been the focus of the construction industry. With sharply increased prices for building materials that far exceed consumer price indices and increased globalization must now streamline the construction industry logistic processes, in order to maintain its competitiveness. An entire economic industry to new models of business processes, management and production methods based on information technologies (Edum et al., 2000).

The quality of large-scale and transformative construction projects determines the complexity of project management; the construction process requires the support of agencies; this feature also makes it difficult to manage construction projects (Igwe et al., 2020) The specific construction required for each construction should include planning, design, tender, procurement, construction, work and maintenance, along with resource-based construction. The unique nature of construction equipment and existing manufacturing methods has long been a source of many problems and troubles, finding the effective ways to control the problems and risks encountered in the construction management process, which is the focus of research.

Some studies have focused on innovative tools used by construction companies, integrated management skills and project management factors. Zhou et al. proposed a model to examine the comprehensive impact of quality, project scope, communication, time, risk, procurement management and human resources on the success of construction projects in Indonesia, Taiwan and Vietnam. The conclusion is that the effective use of the knowledge of the project management organization can ensure the success of the project. Research based on BIM (Building Information Modeling) is being carried out in urban construction projects in China. It is

recommended to improve the quality of urban complex construction projects by using the functions and functions of exchanging information with BIM (Koseoglu et al., 2019).

Lukichev et al. (2016) discussed the implementation of the quality management system and the selection of certification bodies in Russia. It is recommended to improve its competitiveness in the world market after obtaining a certificate from a foreign certification body (Chiarini, 2017) (such as ISO-9001: 2015). Poyhonen et al. Described a real school project from Finland and developed a PDS (Project Delivery System) using an innovative management system (Earnshaw et al., 2018). Someone pointed out that resources and capabilities, market input, development process and strategy are the most important parameters of PDS development.

The conclusion reached is that not only cost, quality and time are critical for construction management, but also planning for construction machinery, safety factors and seasonal effects should be included in the documentation. Saqib Et al. also conducted a survey in two major cities in Pakistan to determine the level of quality management systems for construction projects (Saqib et al., 2008). The results of this study show that although both consultants and contractors understand the importance of QMS, they are all negligent when implementing QMS. However, the aim of this research is to conduct a comprehensive analysis of the workings of quality culture and the factors that determine the quality assurance of construction in Iraq.

The value system of any organization's QC (Quality Control) culture pushes employees to create a quality environment. Continuously increases quality by focusing on practical specialization, procedure, and delivery. Contractors can benefit from a quality control culture to achieve the necessary competitive company performance, customer satisfaction, and social responsibility. The efficacy of the quality control process or quality management system in the construction sector is determined by the combined effect of numerous resources (such as human resources, quality control parameters, materials, machinery, processes, and the environment (Magar et al., 2014).

In the construction industry, it has been recognized that more and more time is devoted to the preparation or verification of contract claims. Its key is to make customers more sophisticated in implementing the requirements of the standard form

of construction agreement. These agreements obviously burden the contractor. Due to the lack of relevant records, the task of providing this type of evidence (usually written evidence) becomes complicated. Therefore, doing things a serious financial loss is usually a big loss and checking project records shows when the problem should be raised until the problem is discovered. This usually does not happen when people do not have professional knowledge or initiatives. Often, over time, they will be overwhelmed by other concerns, so they pay less attention to these issues (Magar et al., 2014).

## **1.2 Construction Management**

Construction management (CM) is one of the other approaches to the project, which has grown in use in the construction industry and housing market. As a result, customers have an additional framework for delivering the project to start projects that can participate in a risky and competent project (de Valence, 2012). This study assesses the risks and opportunities for evaluation in relation to other approaches to CM projects, and confirms that the project delivery method is the most appropriate to use. In addition, the study also examines the level of knowledge about CM in various arts in the Iraq construction industry. The purpose of this study is to increase knowledge about the project distribution and to suggest possible changes in CM usage. Following are the main Factor of quality control.

- a. Human Control
- b. Quality Control Standard
- c. Selection of Optimal Process and Materials
- d. Other Parameters Influencing the Quality Management System

### **1.2.1 Human control**

Human capacity is the most significant aspect in quality control. Employees that are more skilled and efficient can produce higher-quality work. People have the power to govern themselves, and he can control things like quality. The overall management system's speed is determined by collaborative efforts or cooperation. The ability of the leader determines whether an organization succeeds or fails (Bananno, 2004).

### **1.2.2 Quality control standards**

The establishment of a quality management system is thought to be the key to an organization's success since it has the power to integrate, change, and institutionalize quality control methods in everyday practice. The culture, strategic focus, methods, and beliefs of the organization will all change as a result of implementing the established standards. ISO delivers world-class specifications for all types of products, projects, and services to assure safety, efficiency, and quality. ISO delivers strategic direction and solutions to help businesses decrease errors, meet new market needs, and boost productivity. To meet customer needs and quality, some essential customer principles are applied, such as customer intentions, motivations, concerns, continuous improvement, and process approaches (Kartha, 2004).

### **1.2.3 Selection of optimal process and materials**

The most significant activity that directly influences the quality of the project is the selection of materials based on design and environmental requirements. It is critical for each contractor to select materials based on pre-purchase application, design, pricing, environmental conditions, and performance. Before applying environmental conditions and sample size, the materials supply must be accomplished. The study requires a description of the material's features, including equipment selection, varied load and pressure circumstances, test methodologies, test purposes, and special purpose concepts. It is necessary to select the best alternative approach and method (Kartha, 2004).

### **1.2.4 Other parameters influencing the quality management system**

Quality control can be achieved through the efficient use of a good engineering system, a professional system, a quality control system and quality. In the structural engineering process, the role of men, equipment, machines and systems for calculating criteria and the final outcome of the policy to meet specific specifications and meet owner / user needs (Magar, 2014).

Ensuring health and safety, planning and scheduling, employee motivation and safety, technological development, internal and external control, research and development, political influence, employee integrity, budget amount and Bidding requirements are some other factors that affect quality.

Quality control is management that applies to a system used to manage goals. In this case, the goal is to achieve the right performance standard as well as cost. To get the best quality and cheapest price, we consider all the factors that help build quality in a product or service (Bonanno, 2014).

### **1.3 Quality Control in Construction**

Quality can be defined as the level at which a manufacturing company meets its specifications and expectations. The work performed by this control must be appropriate. This can be achieved by inspecting the finished product from the source material. Essential parts of the management before and after the construction are landscape design, mapping and design, warehouse safety, service life, material quality, specifications, material testing and testing of equipment (de Valence, 2012).

The last line of quality control is to inspect what can be included, to inspect construction and its components and to carefully consider project managers / contractors who are well versed in the testing process / timing. For its application, these requirements must be met. An important step in improving performance is to ensure that all goods and equipment included in the project meet the contract criteria and the BIS (BIS standard). BIS-approved materials should be applied as much as possible to the project. If the BIS standard is not for a specific item, the item is purchased from some standard manufacturers and tested in a laboratory (Magar et al., 2014).

### **1.4 Objective**

- a. To study different project currently in-progress or completed
- b. To study different literature related to quality of project
- c. To develop tools or frame work which is ensured the role of project management in quality control.
- d. To elaborate the quality control in the form of Questionnaire format of currently doing project in the Iraq.

## **1.5 Questionnaire Format**

This research was conducted in the construction industry in Iraq. In this study, mixed patterns of quality were adopted. It was used to collect and modify specific data used to evaluate quantitative research. Quality research allows opponents to express an open mind, and their suggestions or ideas change and expand the scope of the results during the analysis. In this study, 40 different questionnaires were included in the preparation of the questionnaire. Also, 26 different questionnaires format for project manager (PM) are used to collect data related to quality of project. Both formats are shown in below chapter number 3.

## **1.6 Scope of Thesis**

This Research work contain the following Chapters

Chapter 1: Introduction

Chapter 2: Literature Review

Chapter 3: Material and Data Collection

Chapter 4: Results

Chapter 5: Analysis

Chapter 6: Discussion

Chapter 7: Conclusions

## **2. LITERATURE REVIEW**

### **2.1 General**

Butnaru, and Miller, 2012 describe that the concept of quality basically comes from Latin and means nature. Furthermore, they explain how the concept has acquired a more general meaning over the years (Butnaru et al., 2012). They refer to Genichi Taguchi who describes that quality is linked to its shortcomings and not the success achieved. Quality deficiencies consist of society's total losses caused after its delivery. The definition can be linked to the losses that a building incurs after a final inspection has been carried out. Deming believes that quality refers to the customer's needs, both current and future needs.

Besterfield, (2004) defines quality as a relationship between the expectations of a product or service and the ability to perform them. Implementation can be seen in the construction process as the ability to deliver the finished product (Besterfield, 2004).

The definition means that if the quality is greater than or equal to 1.0, the quality is perceived as good. A customer who does not have such high expectations or does not know if the result meets the requirements can consider that the quality is good without any major effort in implementation being required. A customer who instead sets high standards and has high expectations needs good implementation to experience good quality (Besterfield, 2004). A customer with high expectations requires a contractor who is able to deliver what is expected in the requirements to meet good quality according to the definition (Endris, 2020).

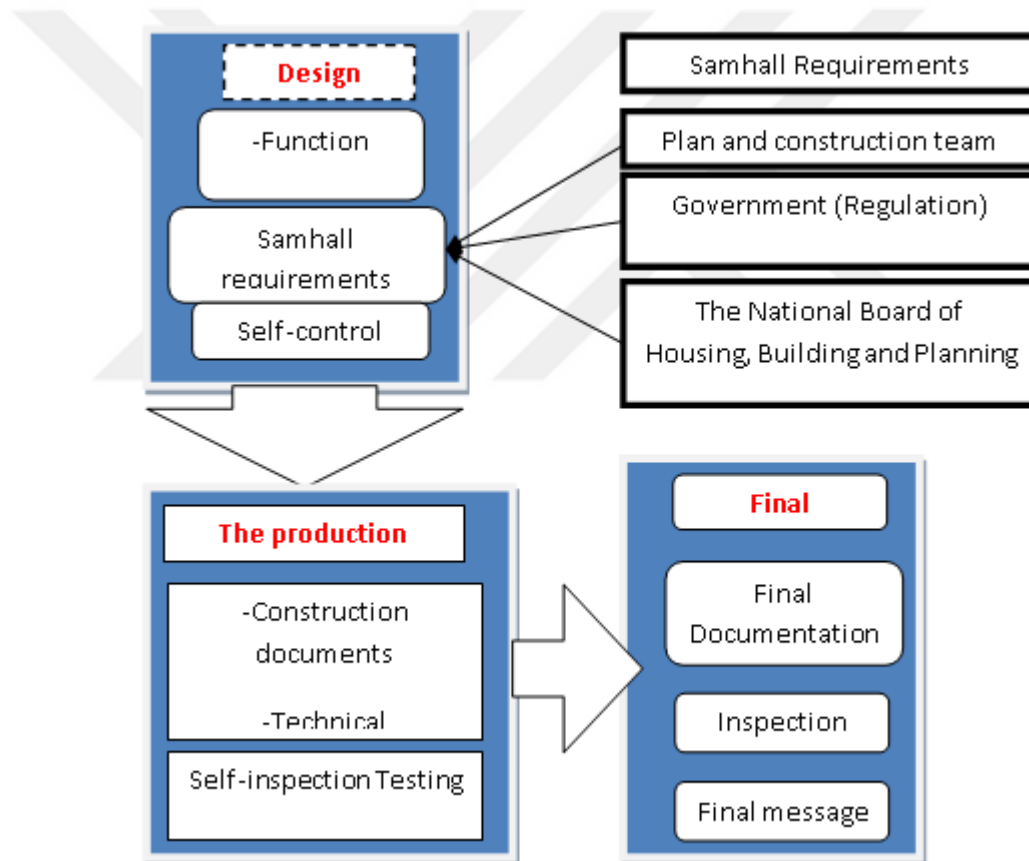
As society and its constituent individuals are constantly evolving, sustainability work also requires constant development. At present, the concept is divided into three dimensions; economic, environmental and social sustainability. The latter dimension is the one that is currently most relevant to develop for companies in the construction industry, when the Government Offices on 1 January 2017 updated the Public Procurement Act (SFS 2016: 1145), for that the ILO intends to introduce a new law regarding labor law conditions that will enter into force on 1 June 2017 and that the

government has produced new directives for procurement of goods and services (Nagel, 2018).

In addition to this, in 2015 the EU developed new global goals with the aim of contributing to a more inclusive society with reduced inequalities

## 2.2 The Quality Process in a Construction Project

The section deals with the structure of the process from design to inspection. The structure of the process is illustrated in Figure 2.1. The figure shows a simplified picture of what the requirements-setting process looks like from the client starting a project until a final decision is given and the building can be taken into use.



**Figure 2.1:** Illustration of The Construction Process

## 2.3 Design

Planning a job offers several benefits. It can help keep times, achieve the right quality and acquire the right resources (Révay et al., 2012). According to ISO 9001, the management team for the design must define a policy for quality (SIS 2015). The policy must be well formulated in order to be fulfilled during the design of a project.

During the design, the requirements must also be verified and secured. To ensure that all documents are correct, they must be well documented and reported in a clear manner. During the design, the requirements for the project are identified. The requirements are categorized as societal requirements and customer requirements.

### **2.3.1 Customer requirements**

Depending on the project, the client can set different requirements for the construction work to be erected. The requirements may concern environmental requirements, technical requirements or purely functional requirements that the contractor must take into account and meet (Gann et al., 2000). If a contractor complies with the contract law provisions, AB 04 or ABT 06, there is a requirement that the contractor must perform checks on work performed. These controls form a control plan. The inspections are a legal security for the client and verify that the work has been carried out correctly.

### **2.3.2 Social requirements**

The Planning and Building act contain provisions and requirements for the construction and planning of water and land. The regulations aim to give every human being equal condition to good living conditions in the present and for future generations (Chudley et al., 2013). PBL has regulations for how municipalities must draw up detailed plans and general plans and more. There are also technical requirements for the building that must be met. It can be the construction of the house, fire safety and protection against noise. These requirements must be met for the building to have an approved and good quality from a societal perspective.

## **2.4 Production**

### **2.4.1 Control plan**

The control plan is a document that the client is obliged to prepare. The document governs which self-inspections are to be carried out during the construction process and which requirements the building must meet. At the start notice, the control plan becomes an agreement that must be fulfilled by the client vis-à-vis the building committee. It will be the contractor's task to follow the control plan during production. The control manager follows up the control plan for the customer (Forcada, 2005).

### **2.4.2 Industry rules**

AMA is an industry standard for the construction and design of buildings. AMA's standards exist for several different actors such as houses, plumbing and electricity and more. The design of the administrative regulations is also described in the AMA standard. The Swedish Construction Service publishes AMA's standards. The construction methods in the standards are proven and this is often where the projectors refer (Ekholm, et al. 2000).

### **2.4.3 Self-checks**

To ensure that the work is carried out in accordance with the norms and rules that apply to the industry, as well as check the customer's requirements, the contractor performs self-checks. The self-check acts as verification for the customer to ensure that the work is carried out correctly. It is then essential that the controls are documented so that they can be reviewed afterwards (Chudley et al., 2013).

Sandelin and Mattsson (2019) investigate how the self-control system works in production in the construction industry. The survey shows that there is a low level of trust in self-controls and their function. It appears that self-checks are often done afterwards and that they then do not fulfill any function. There is also a great deal of ignorance behind what self-control is for. The biggest reason for the low confidence is said to be the lack of motivation and ignorance of those who perform the checks. Suggestions are given that companies should create their own self-inspection systems to clarify what the purpose of the self-inspections is. However, the survey is narrow and reflects only a small part of the construction industry. However, the result can be compared with what the National Board of Housing, Building and Planning writes in its report that lack of competence and motivation is behind large parts of the construction defects (Carlsson et al., 2019).

### **2.4.4 Testing**

To ensure that the function of a building is correct, functional tests can be performed. These tests can be performed on, for example, a ventilation unit to ensure that the system meets the requirements. Several different actors can be present at the test, for example inspectors, the installer and the contractor. The test must usually be documented (Najafi, 2010).

#### **2.4.1.1 Final documentation**

According to the agreement, the contractor must submit a final report with the documentation prepared during the project. The documentation must also contain the checks that have been performed in accordance with the agreement (Goldstok, 1991).

#### **2.4.1.2 Inspections**

One way to check the building structure before it is taken into use is through inspection (BFS 2019: 2). The inspection is a method to check that the work meets the requirements set by the client and to check that the work has been carried out correctly.

#### **2.4.1.3 Final message**

The final decision is given by the building committee when the building has been shown to meet the societal requirements imposed on the building according to PBL. The notice means that the building may be taken into use (Najafi, 2010).

### **2.5 Quality Management During Production**

Josephson (2013) describes how quality management is based on two main aspects that together form a holistic view of entire projects. The factors are essential for the construction process and are described as

- a. Leadership for employees
- b. Structured processes.

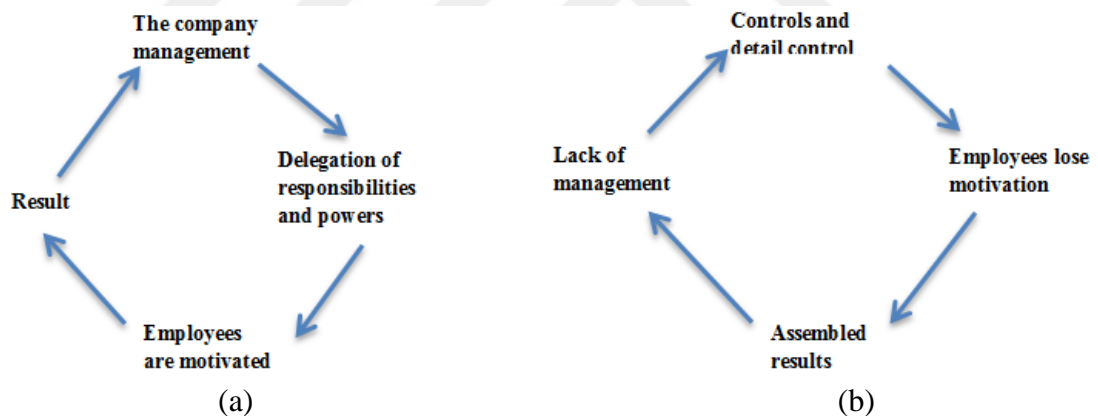
These two factors build the core of quality management. In this way, a long-term success will be built in the projects. Egan (1998) clarifies, through his evaluation of the UK construction sector, in a report the importance of leadership for quality. Achieving good quality not only means that the end product must be flawless, but that it must be right from the start. The focus must be on delivering the best possible end product to the customer. The working method requires clear leadership and motivated professionals with the right training for success to be possible. The importance of leadership for quality management is also described by Deming (1986) as one of the most significant factors in achieving higher quality (Goldstock, 1991).

### 2.5.1 The importance of leadership for quality

With the help of fourteen points, Deming (1994) describes how leadership has a central part in quality work. The points are a guide to what leadership should focus on and how it should be designed. The view is that leadership is the basis for increased quality (Waldman, 1994).

Deming (1994) defines that a leader must be able to change an organization; the person must have knowledge, a good personality and a persuasive power. A leader must be clear about what the goal is and how the employees will get there together. The leader helps his workers understand that they are important and that their work contributes to achieving the goals (Waldman, 1994).

Bergman and Klefsjö (2018) describe how a leader can strengthen professional pride through positive leadership where employees gain a great deal of trust (Harrington et al., 2012). The increased professional pride thus contributes to an increased awareness of quality, see Figure 2.2.



**Figure 2.2:** (a) The Good Leadership Culture, (b) The Bad Leadership Culture

**Source:** Bergman & Klefsjö (2018)

However, it is clarified that incorrect leadership can create negative trends within the organization, which contributes to poorer quality, see Figure 2.2b. Deming (1986) also believes that professional pride contributes to increased quality and that professional pride comes from the fact that management gives a great deal of responsibility (Waldman, 1994).

Controls can reduce the motivation to perform a job with the right quality, which shows the bad leadership culture (see Figure 2.2b). Deming (1986) describes how controls reduce the will to do right from the beginning. To perform a check of a

finished work is to make the check too late. The error has already occurred while performing the check. Fixing errors is partly costly but also causes duplication of work that lacks value creation. The controls should instead be replaced by an improved way of working, Deming believes (Negal, 2018).

### **2.5.2 Total Quality Management**

Total quality management (TQM) as a work with continuous improvement. The way of working is not based on an individual way of working in an organization but a way of working with quality in the long term (Talha, 2004). The authors' definition of TQM is offensive quality development, which is based on a company wanting to work towards improvement. In summary, the authors summarize the foundations of the working method in five points:

- a. Put customers in focus
- b. Base decisions on facts
- c. Work with processes
- d. Work on continuous improvement
- e. Create conditions for participation.

Based on the points, an organization can adapt its way of working to suit the current industry. These points also form the basis for the design of the quality certification ISO 9001. TQM should not be seen as a way of working that can be quickly applied in a company but as a philosophy of quality with the customer in focus.

According to TQM, the quality must come from the management. Harrington, Voehl, & Wiggin (2012) describe TQM as a tool that can be suitably applied in the construction industry to increase quality and increase productivity. The working method is based on the organization purposefully stepping in to work towards continuous improvement with a leadership that is based on benefits for employees and more training. At the center of the working method is a large customer focus. Harrington et al. (2012) explain, however, that ISO 9001 is misunderstood as the only part of TQM that can be applied to the construction industry. The working method must be adapted to the company but must lead to a culture within the company where quality is in focus.

Highlights the difficulties of introducing TQM in the construction industry and using it in entire construction projects. The reason is stated to be that the model is based on

the subcontractors also having to follow the working method in an equivalent manner. The culture with quality in focus must be present throughout the construction process to give a good result (Talha, 2004).

Emphasize that it is important not to stick to a certain name or a certain production system. The focus of the work should be on what a quality tool contains and what creates value for the process. There is nothing wrong with combining different quality management systems, but rather it can be to the benefit of the organization. It is about creating systems that suit the current type of production (Waldman, 1994).

## **2.6 Implementation**

Implementing a new way of working requires an understanding and will from everyone involved for the work to succeed. To succeed in implementing new systems, the entire corporate culture and structure must change. The leadership in the whole process must be clear and everyone must be aware of how the qualitative work is to be carried out (Negal, 2018).

Explains through eight points how the implementation of new methods should gain a foothold in an organization. He explains how the need for change must be highlighted in order to convince people that change is necessary. People need to see the benefits of change for the job to succeed. It is not enough that a few people work with change, the whole organization must work towards change. It is also important not to finish a change work before the culture is consolidated in the organization (Bonanno, 2004).

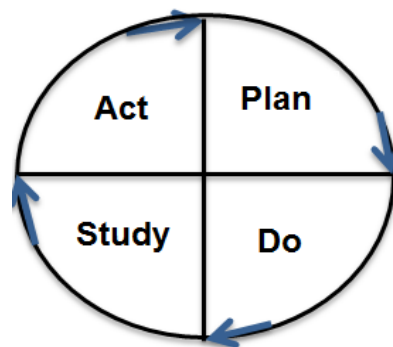
Attempts have been made to introduce industrial quality control from the automotive industry, such as Lean production. However, it has proved problematic to implement and consolidate the systems in the construction industry (Sullivan 2011). Furthermore, Sullivan believes that it has a greater effect to develop existing systems instead of trying to implement new ones. This is supported who believe that it is routine and experience that contribute to better quality. They further explain leadership as a significant factor for development. If the problem-solving ability and the feedback of experience are to be developed, leadership is important regardless of the type of control system used (Nagel, 2018).

Describes that the construction of the construction sector makes it problematic to implement more industrial quality methods. When prefabricating building components, a more industrial way of building can be met, but works or buildings erected at the workplace have problems meeting the criteria for industrial construction. The forms of contracting in the construction industry can also prevent the construction industry from working towards more industrialized construction methods. Each contractor is procured individually and the incentives do not benefit the collaboration in the project (Ingelsson et al., 2018).

## 2.7 Standardization

Describe how people develop by gaining a holistic view and responsibility for the product or service they perform. They describe the importance of identifying processes in order to be able to develop the working method. The development of processes is described as an ongoing work. Through Deming's improvement cycle (see Figure 3), how the systematics of the work towards continuous improvement is visualized and concretized (Nagel, 2018).

According to the improvement cycle, the work must be planned and carried out and then analyzed. Based on the evaluation, lessons learned about what has gone well or worse can then be evaluated. In this way, work steps can be developed and the entire development process standardized.



**Figure 2.3:** Bergman and Klefsjö's (2018) Translation of Deming's Improvement Cycle.

Standardizing documentation creates a more efficient flow of information. By creating a standard for how documentation and communication within the project is to be carried out, construction can be made more efficient. With interactive tools, the

working method can be facilitated, which generates a desire to create a good and well-functioning documentation (Waldman, 1994).

## **2.8 ISO 9001**

ISO 9001 is an international standard of the quality management system for companies and organizations (SIS 2015). The standard exemplifies and specifies working methods from TQM and is based on the improvement cycle's standardized learning (see Figure 2.3) and Deming's theories of quality management. The core of the standard with regard to quality management is based on the following eight principles:

### **1. Customer Focus**

By studying the customer's needs and understanding what he needs, the product can be developed.

### **2. Leadership**

The leadership must lead the employees towards a common goal and let them focus on achieving the goal.

### **3. Employee Commitment**

The organization must work to ensure that all employees are involved by ensuring that everyone has the right education. The organization must also work for a good culture within the company.

### **4. Process Orientation**

By developing repetitive elements within the company, the organization can be improved and streamlined.

### **5. The System Approach to Management**

The organization must work to be as efficient as possible by evaluating what the decision-making processes look like.

### **6. Continuous Improvement**

By investigating errors that occur, the organization can be improved and streamlined. The organization must learn from past mistakes.

## **7. Fact-based Decisions**

Decisions must be based on facts.

## **8. Mutually Beneficial Relationships with Suppliers.**

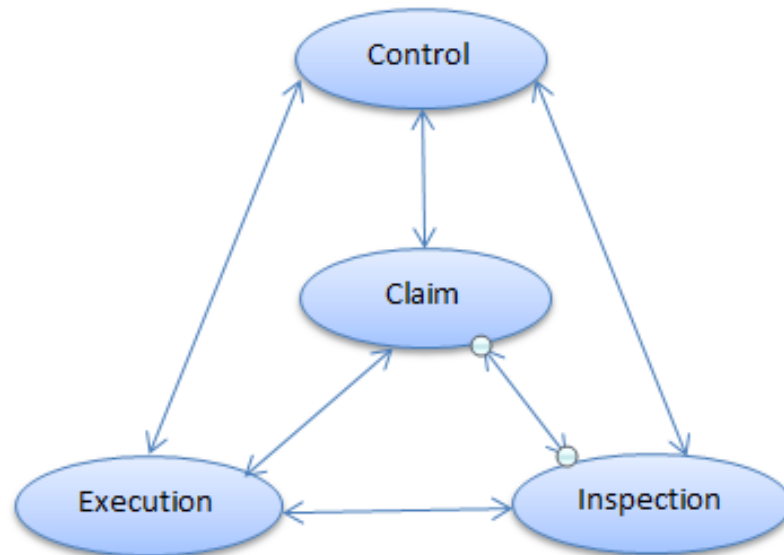
The importance of good cooperation with subcontractors must be taken into account, both parties must benefit from cooperating.

Through these points, the process must be improved and lead to a high-quality end product (Hansson et al. 2015).

A study examines whether quality management systems such as ISO are applicable to measure quality in the construction sector. According to the report, it is essential to look at the company from different perspectives to get the best possible result. For example, the perspectives of finance, the customer, the process or learning can be taken into account. It turned out that if there is a balance between the different perspectives, the system can be successful. The problem is that there is often no balance between the various factors. The study also shows that it is very problematic to conclude that investing in quality certification systems contributes to better quality. There is no direct concrete evidence that it works. A functioning system can contribute to increasing quality, but often more is invested in blind belief that they work, rather than fact-based evidence.

## **2.9 Digitization**

To describe BIM as a digital model for buildings, this forms an information system. The information can be distributed via a digital cloud service that collects information in the form of digital 3D models, drawings, descriptions, controls and more. The software organizes the information in a well-structured way, which is also constantly updated. BIM can provide the components of a digital model with data in a concise way. Examples of cloud-based BIM services are BIM-360 and Bluebeam Revu. How the information from separate elements is linked together and processed with the help of BIM in quality management is illustrated by Figure 2.4. The information flow is linked together and thus becomes more manageable. Digitization means an increased overview of documentation and information for quality management (Koseoglu et al. 2019).



**Figure 2.4:** The Flow of Information with Regard to Quality in Production Using BIM

Through complex information flows, individual components of the project can be followed. Several players can collaborate and put together an end product of the right quality. The production chain thus becomes more industrialized. However, the construction sector has had problems implementing digital joint systems as several actors operate in parallel with the same project. The difficulty in increasing digitization in an efficient way is to find a system that can be integrated with the whole process. The information must follow a flow that is manageable and structured to create added value in the production (Nagel, 2018).

To be able to apply BIM programs in a construction project, training and knowledge from users about the program is required. One reason why the programs have not previously been used in a widespread way is the large work effort at start-up. There are also risks that smaller companies will not be able to make the investments or are afraid that the adjustment cost will not pay off. It is also important to consider that in addition to investments in training and software, the entire company's documentation structure may need to be changed to adapt to the software, which may make implementation more difficult. It can also be a reason why the application of BIM is slow (Koseoglu et al. 2019).

Highlight that several of the disadvantages of BIM are linked to the software. The advantages are considered to be that BIM reduces production costs and increases quality. Above all, BIM is said to be able to facilitate and strengthen project

management (Koseoglu et al. 2019). The benefits from an economic perspective are who in a study show a total saving on the entire project of two percent compared to a project that does not use BIM.



### **3. MATERIAL AND DATA COLLECTION**

#### **3.1 General**

This chapter presents the method used to collect data for the work and the presentation of the selected methods.

#### **3.2 Preliminary Study**

The feasibility study consisted of a literature study and semi-structured interview plus a questionnaire survey. Eriksson write that the greater the investigator's opinion on the subject, the better the interview will be (Eriksson, 1988). If the investigator is well acquainted with the subject, he or she can formulate the questions better and then get a chance at a good result for the report. To gather as much information as possible, a literature study was conducted. The literature study created a theoretical background to the problem. It also gave a deeper understanding of the problem.

An interview with a control manager with long experience in the industry was conducted to add the client's perspective on the problem and provide a broader picture of the subject.

Another interview with an aftermarket manager was conducted to get an insight into where the problem lies after completion. The interviews were conducted at an early stage to gain a better understanding of the subject. The feasibility study resulted in an appropriate method choice for gathering empirical data was an interview study.

#### **3.3 Semi-structured Interview Method**

To give the respondents the opportunity to develop the answers, it was chosen that the interview study would be carried out through semi-structured interviews. Writes that in a semi-structured interview, the researcher has ready-made questions with a specific theme that are to be touched upon. The questions can be asked in different order and new questions may arise during the interview. It is important that the interviewee feels free and can design the answers in their own way. Usually, the

questions are asked in the order planned. Describe the difference between a survey and an interview. In interviews, the participant can develop the answers better, and this then gives a better explanation of why the person answers as they answer. The risk with surveys is that the answers are not as developed and that's because the closed-ended questions.

The main questions in the interview study were asked in the same order to the project managers. To provide an opportunity to develop the answers and deepen the discussion, a number of sub-questions had also been prepared. These questions were asked depending on how the respondent developed the answer to the main question. The project manager interview questions format can be found in Appendix A.

The semi-structured interviews may be conducted via phone call. To make it easier for the respondents, it was therefore chosen that the interviews would be conducted via a platform they were used to working with. The interviews were conducted with a webcam on the interviewers and in some cases the respondents also used their webcam. No technical problems arose during the interviews. At each interview, the respondents were informed about the willingness to participate, the interviewers introduced themselves and also had the respondent explain their background.

### **3.4 Data**

All interviews were noted, which meant that the interviews/questioner's format could be processed afterwards. Respondents' responses from each interview/ questioner were summarized separately. After all interviews/questioners were conducted and summarized, the answers could be systematically worked through.

### **3.5 Selection**

For the interviews, a specific occupational category was selected; the occupational category chosen was project managers for the interview and site engineers for the questionnaire. The reason why the project manager was chosen was that they are responsible for the quality of the project; therefore, the project manager was considered relevant respondents to the interviews/ questioners.

As for the questionnaire, the selected category is the site engineers in addition to a few project managers in order to obtain a more comprehensive result and to see

whether the result obtained from the questionnaire and site engineers is identical or close to the result obtained from the interviews that took place with project managers

### **3.6 Observations**

Describe that observations are suitable to use to study events that are obvious to humans. Things that are taken for granted by other people are difficult to find out through interviews. Therefore, site visits to a construction site may be appropriate to increase understanding of why respondents respond as they do. It could also provide an in-depth picture of the quality work and an opportunity to discuss the quality work in more detail. Due to the ongoing pandemic, site visits to construction sites were not possible.

As for the date of the interviews the interviews were conducted at the beginning of October of the year 2020 and continued until the February month of the year 2021. Some interviews were conducted before this date to get an initial idea of the study.

## 4. RESULTS

### 4.1 General

This chapter shows the empirical study that consists of the answers from the semi-structured interviews and the data collected from the questionnaire survey. Subject categories are used to categorize the responses. Appendix A contains the interview questions and Appendix B contains the questionnaire survey.

### 4.2 The Interview Respondents

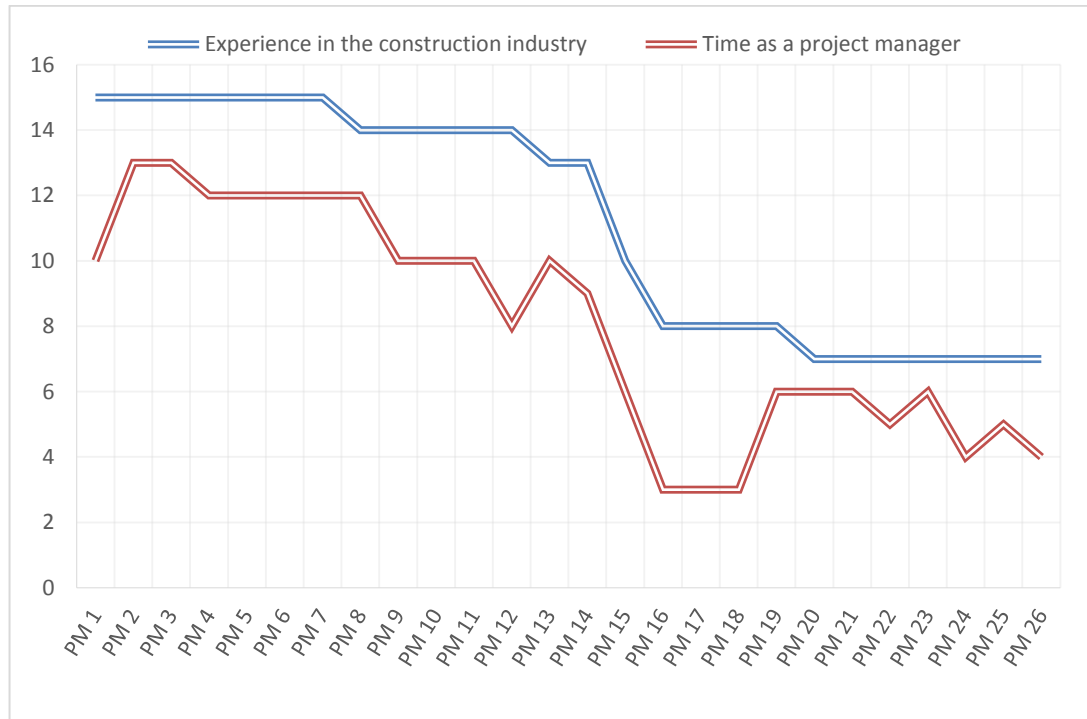
Table 4.1 and Figure 4.1 present the list of the project managers who participate in the interviews, together with their personal information, industrial experience, and their time as a project manager.

**Table 4.1:** The Project Managers Who Participate in the Interview and Some of Their Personal Information

SEQ.	Project Managers Number	Age	Company's Name	Company's City	Experience In The Construction Industry	Time As A Project Manager
1	PM 1	43	Middle East Engineering LLC (MEE-US)	BAGHDAD	15	10
2	PM 2	44	The Iraq Group for General Servic (I.G.G.S)	BAGHDAD	15	13
3	PM 3	44	Al Diwan Engineering Design Co.	BASRA	15	13
4	PM 4	42	Al-Mansour General Construction Co.	BAGHDAD	15	12
5	PM 5	43	Al Sama Tower Contracting & Engineering Consulting Co.	SULIMANIYAH	15	12
6	PM 6	42	Baroque Building Contracting Co.	BASRA	15	12
7	PM 7	43	Al TEPAQ General Contracting Co. Ltd	NAJAF	15	12
8	PM 8	42	D. Jerusalem Co.	BAGHDAD	14	12
9	PM 9	41	Taha & Partners Group	BAGHDAD	14	10
10	PM 10	42	Al Tebaq General Contracting Co. Ltd	NAJAF	14	10
11	PM 11	43	Al Zareef Company Ashur General	KARBALA	14	10
12	PM 12	40	Construction Contracting Co.	BAGHDAD	14	8

**Table 4.1:** Continue

SEQ.	Project Managers Number	Age	Company's Name	Company's City	Experience In The Construction Industry	Time As A Project Manager
13	PM 13	39	Al Fahad for General Contracting Co.	AL ANBAR	13	10
14	PM 14	39	Southern Parties Company	BASRA	13	9
15	PM 15	37	Wadi Baghdad General Contracting Co. Ltd	BAGHDAD	10	6
16	PM 16	34	Al Khairan General Contracting Company	BAGHDAD	8	3
17	PM 17	33	Al Majd Al-Daameen General Contracting Co Ltd	BAGHDAD	8	3
18	PM 18	34	Al - Atiab Company for Contracting Co.	NAJAF	8	3
19	PM 19	35	Green Easy Road General Contracting Company Ltd	KARBALA	8	6
20	PM 20	36	Al Fijaj Company for Construction Projects	BAGHDAD	7	6
21	PM 21	34	Basra Mas Company	BASRA	7	6
22	PM 22	36	Al - Abraj Company for Contracting	BASRA	7	5
23	PM 23	34	Saline Contracting & General Trading Co	KIRKUK	7	6
24	PM 24	31	AL SAMA Engineering Consultants (pvt) Ltd	BAGHDAD	7	4
25	PM 25	34	Ashur General Construction Contracting Co.	BAGHDAD	7	5
26	PM 26	35	Square Contracting Company	BABIL	7	4

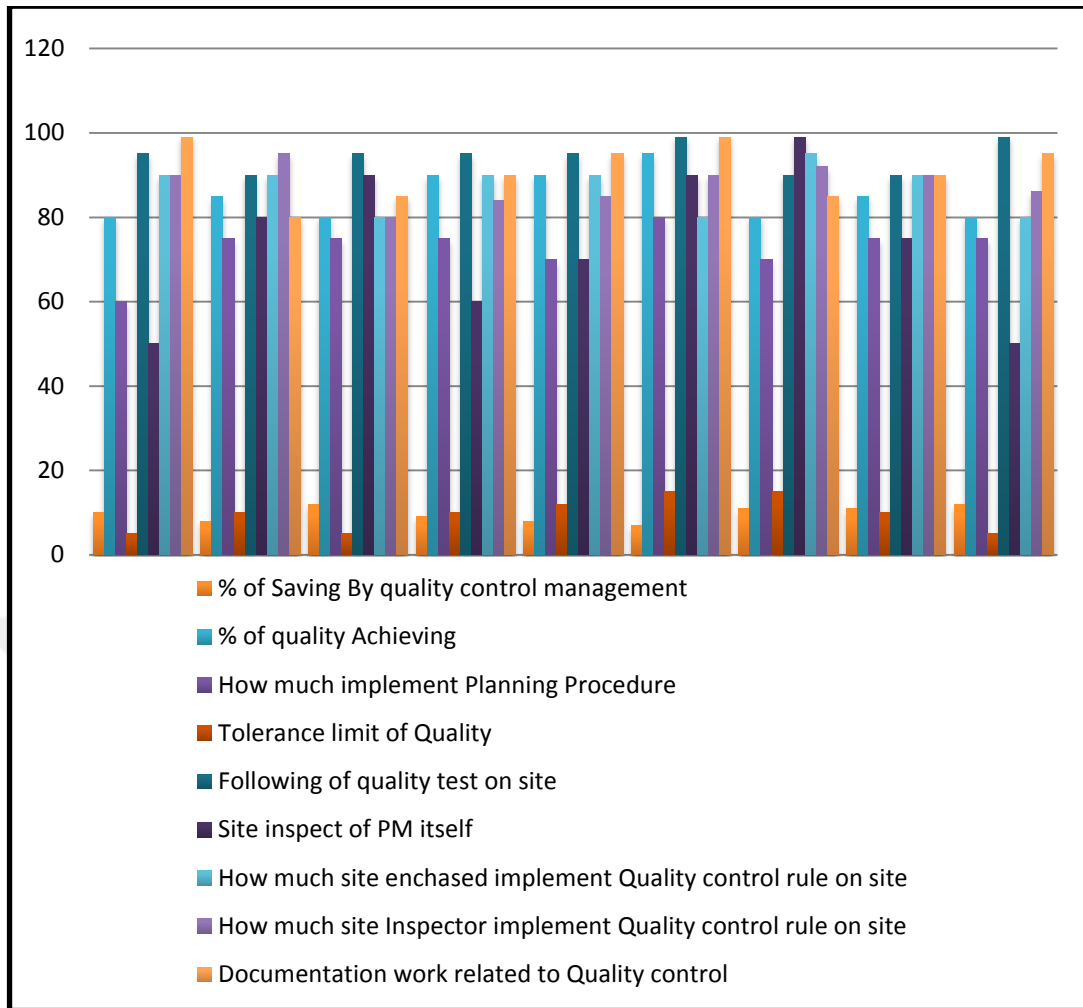


**Figure 4.1:** Graphical Representation of a Project Manager's Professional Experience

The result of Project manager related to quality control is given in table 4.2.

**Table 4.2:** Quality Control Result from Project Manager’s Questioner Format

SEQ.	Project Managers Number	% of Saving By quality control management	% of quality Achieving	How much implement Planning Procedure	Tolerance limit of Quality	Following of quality test on site	Site inspect of PM itself	Documentation work related to Quality control	How much site enchased implement Quality control rule on site	How much site Inspector implement Quality control rule on site
1	PM 1	10	80	60	5	95	50	99	90	90
2	PM 2	8	85	75	10	90	80	80	90	95
3	PM 3	12	80	75	5	95	90	85	80	80
4	PM 4	9	90	75	10	95	60	90	90	84
5	PM 5	8	90	70	12	95	70	95	90	85
6	PM 6	7	95	80	15	99	90	99	80	90
7	PM 7	11	80	70	15	90	99	85	95	92
8	PM 8	11	85	75	10	90	75	90	90	90
9	PM 9	12	80	75	5	99	50	95	80	86
10	PM 10	7	90	75	10	99	40	80	85	88
11	PM 11	15	80	70	12	90	90	85	85	90
12	PM 12	14	90	80	15	95	50	90	80	92
13	PM 13	8	90	75	15	95	80	95	80	80
14	PM 14	9	95	75	10	95	80	95	95	85
15	PM 15	7	80	70	12	99	95	99	90	90
16	PM 16	5	85	80	15	90	86	85	90	95
17	PM 17	9	85	70	15	90	75	90	80	93
18	PM 18	10	80	75	10	99	90	80	95	80
19	PM 19	12	90	75	5	99	99	85	90	85
20	PM 20	9	80	75	10	99	75	90	80	82
21	PM 21	6	90	70	10	90	50	95	85	86
22	PM 22	8	90	80	10	95	40	99	85	87
23	PM 23	7	95	75	12	95	90	85	80	90
24	PM 24	11	80	75	15	95	50	90	80	92
25	PM 25	8	90	70	15	90	80	95	95	95
26	PM 26	12	80	80	10	95	80	80	90	95



**Figure 4.2:** Graphical Result of Project Manager Questionnaires' Format

### 4.3 The Data Collect from Questionnaire Survey

The data collected from the questioners for sixty-five engineers with their information is given blow in table 4.3.

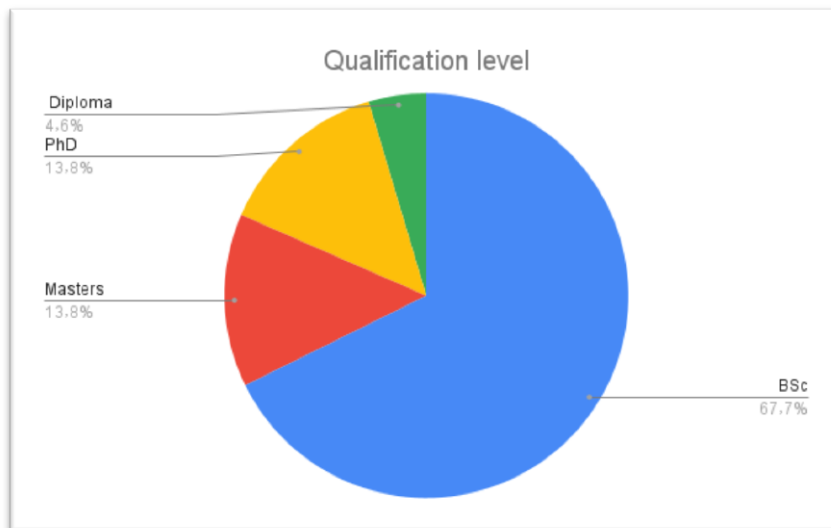
**Table 4.3:** Distribution of the Questionnaire Survey Sample According to the Personal Variables

Variables	Categories	Frequencies	Percentage
<b>Age</b>	< 25 years	6	9.2%
	25-35 years	43	66.2%
	35-45 years	10	15.4%
	> 45 years	6	9.2%
<b>Gender</b>	Female	6	9.2%
	Male	59	90.8%

**Table 4.3:** Continue

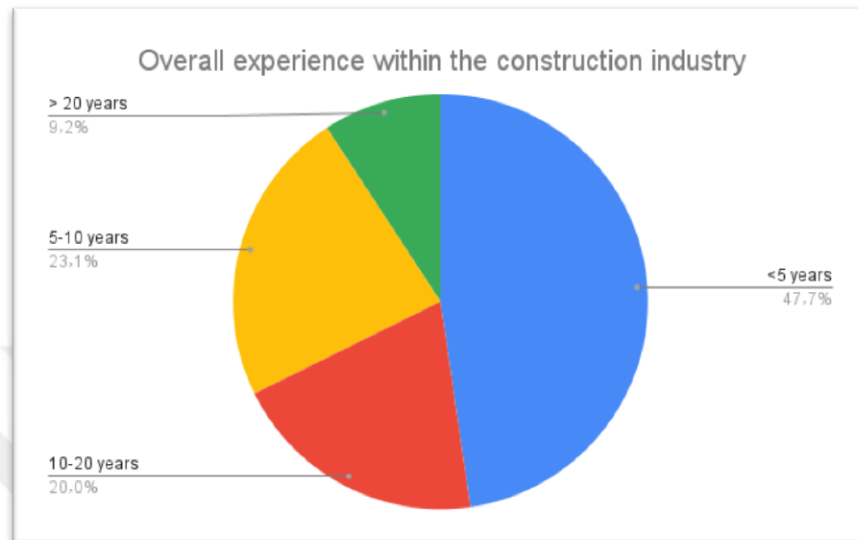
<b>Variables</b>	<b>Categories</b>	<b>Frequencies</b>	<b>Percentage</b>
<b>Qualification Level</b>	Diploma	3	4.6%
	BSc	44	67.7%
	Masters	9	13.8%
	PhD	9	13.8%
<b>Overall Years Of Experience</b>	0-5 years	31	47.7%
	5-10 years	15	23.1%
	20-10 years	13	20.0%
	> 20 years	6	9.2%
<b>Years Of Work In The Company</b>	< 5 years	43	66.2%
	5-10 years	9	13.8%
	20-10 years	10	15.4%
	> 20 years	3	4.6%
	Total Sample	65	100%

We should note that the above table with regard to the sample member's educational qualifications background that the highest percentage was for those with a bachelor's degree, with a percentage of (67.7%), which is the largest percentage of the sample.



**Figure 4.3:** Qualification Level

With regard to experience, the dominant magnitude was (47.7%) of those whose experience ranged from (0-5) years, then those whose years of experience ranged from (5-10) years (23.1%) and then their years of experience ranged from (10-20 years) with (20%) and (9.2%) with experience years more than 20 years.



**Figure 4.4:** Overall Years of Experience

And with the same mechanism the age, gender and the years of work in the company is given in the table 4.3.

In the next section, the questions will be discussed individually and some details of each question will be given.

#### 4.3.1 Common quality control practices in construction sector questions

1. Have you used any form of quality management system in the construction industry?

Answer	Frequencies	Percentage
No	19	29.2%
Yes	46	70.8%
	65	100%

The use of the quality management system has an effective role in maintaining the application of specifications and ensuring that the work is going according to the required quality, and according to the results of the survey, it was found that 70.8% use the quality management system in their projects and the rest do not use it, and this does not mean that there are no quality standards. There are many requirements

to complete the work according to a specification required in every project that has work.

2. Have you ever been communicated or advised about quality management from senior management in your current project?

Answer	Frequencies	Percentage
No	21	32.3%
Yes	44	67.7%
	65	100%

The presence of reporting on the quality management system is evidence that the project is subject to the quality management system, through the results of the questionnaire it was found that more than two thirds of the engineers in the work sites were informed and notified about the quality management system by their project management, while 32.3% they were not notified.

3. Are you currently using any of these quality management systems on your project?

Answer	Frequencies	Percentage
ISO 9000	9	13.8%
Custom	3	4.6%
Client	3	4.6%
Checklist	15	23.1%
Specialist Sub Contractor System	23	35.4%
None	12	18.5%
	65	100%

Based on the results of the presented questionnaire, it was found that no less than 81.5% use QMS tools (13.8% use ISO 9001, 4.6% use CUSTOM, 4.6% use Client, 23.1% use checklist, 35.4% use a specialist sub-contractor system) while only 18.5% do not use any of the above, and there may be other standards they use, such as ISO 14000 and others.

4. Do you use any of the following activities in order to ensure quality in your current project?

Answer	Frequencies	Percentage
Quality Planning	15	23.1%
Pre-Established Criteria	3	4.6%
Quality Control Technique	16	24.6%
All of the Above	12	18.5%
None of the Above	19	29.2%
	65	100%

The use of activities to ensure the work of the quality management system is conclusive evidence that the project is subject to the inspection of the quality management system through the questionnaire. It was found that 23.1% use quality plans, 4.6% use pre-establishment, 24.6% use quality control, 18.5% They use all of the above, while 29.2% do not use any of them and may use other methods such as direct observation and others.

5. Do you use a quality register on site?

Answer	Frequencies	Percentage
Weekly	25	38.5%
Monthly	19	29.2%
Sporadically	6	9.2%
Never	15	23.1%
	65	100%

The use of the quality register on the site is a good indicator, and as indicated in the questionnaire, there is a discrepancy in the duration of quality registration for my agencies, as 38.5% register on a weekly basis, 29.2% register on a monthly basis, 9.2% register intermittently and 23.1% They don't register.

6. In direct comparison to that of health and safety on site; please give your opinion on the importance of quality management in your construction project.

Answer	Frequencies	Percentage
More	21	32.3%
Same	37	56.9%
Less	7	10.8%
	65	100%

The quality management system is closely related to occupational safety and health. Through the questionnaire, it was noted that 32.3% voted for the quality management system to be more important than occupational safety, in that 56.9% voted that it is of the same importance and only 10.8% voted on It is less important than occupational safety.

7. How do you rate the attention of your company gives to quality management in comparison to that of H&S?

Answer	Frequencies	Percentage
More	18	27.7%
Same	38	58.5%
Less	9	13.8%
	65	100%

The interest in the quality management system is evidence of the company's sobriety through the results of the questionnaire. It was found that 27.7% of companies give this system more importance than health and safety, 58.5% give it the same importance, while 13.8% give it more importance less than health and safety at work.

8. Do you think each site should have a quality manager responsible for implementing quality plans and checklists?

Answer	Frequencies	Percentage
No	3	4.6%
Yes	62	95.4%
	65	100%

95.4% of the respondents in the questionnaire indicated the importance of having a person responsible for the quality management system, quality scheme and checklist, while only 4.6% voted no.

9. Do you feel that a quality management system is a necessity for the site team to deliver a project with zero defects?

Answer	Frequencies	Percentage
Strongly Agree	28	43.1%
Agree	37	56.9%
	65	100%

100% of the respondents in the questionnaire voted that the quality management system connects the work team in the site without any defects, and the voices were clarified about that, as 43.1% of them voted to agree strongly and that 56.9% voted for the agree.

10. In a typical working week; do you feel that spending time to ensure quality is important?

Answer	Frequencies	Percentage
Strongly Agree	33	50.8%
Agree	26	40.0%
Neutral	3	4.6%
Disagree	3	4.6%
	65	100%

The appropriate time in quality control is very important, through the questionnaire it was found that the elapsed time is important in quality control, as the percentage was 95.4%, provided that time should be provided for quality control and the percentage was distributed as follows (50.8% strongly agree, 40% agree, 4.6% find it normal) while 4.6% do not agree.

11. Have you ever received training in any form of quality management system?

Answer	Frequencies	Percentage
No	27	41.5%
Yes	38	58.5%
	65	100%

Through the results of the questionnaire, it was found that 58.5% of the voters received training on the quality control system, while 41.5% did not receive any training. Therefore, lessons must be provided for quality control and project progress within the required quality.

12. Do you feel site managers need to be trained in quality management skills?

Answer	Frequencies	Percentage
No	3	4.6%
Yes	62	95.4%
	65	100%

95.4% agree that the manager must be experienced in the skills of the quality management system, in good that only 4.6% do not find this necessary, but from the point of view of the workflow, the project manager must be experienced in a system that contributes to the progress of the project within the quality without any defects.

13. Would you be spending more time to achieve zero defects if there were incentives provided to you?

Answer	Frequencies	Percentage
No	6	9.2%
Yes	59	90.8%
	65	100%

90.8% of the voters indicated that they spend a lot of time in quality control at work, while only 9.8% do not spend much time, and according to the above percentage, the importance of having a person responsible for quality control.

14. Do you agree quality management systems help reduce defective work and the number of snag corrections in your current project?

Answer	Frequencies	Percentage
No	6	9.2%
Yes	59	90.8%
	65	100%

90.8% of the voters indicated that the quality management system during work reduces potential defects during the work, while only 9.8% do not agree

Through all the above-mentioned results, it is clear that the quality management system is applied at a very good rate, not less than 83.52%.

### 4.3.2 Experience of respondents in quality management system questions

1. How much % of construction money can be saved by using quality control management?

Answer	Frequencies	Percentage
5%	6	9.2%
10%	35	53.8%
15%	15	23.1%
More Than 15%	9	13.8%
	65	100%

Through the questionnaire , and through the accumulated knowledge as a result of experience in the field of civil engineering and based on the questionnaire submitted, the results were as follows (9.2% voted that the quality control system saves 5% of the contract value, and 53.8% voted that the quality control system saves 5% of the contract value, and 53.8% voted that it can save 10% of the value of the project, while 23.1% voted that it affects 15% and 13.8% voted that it affects no less than 15%. Through all the results presented, we note from the undoubtedly that it part of the value of the project is reserved for no less than 5% and up to more than 15%, which confirms the importance of this system.

2. To get excessive workability of concrete how much extra water, workers are adding during pouring of concrete?

Answer	Frequencies	Percentage
0.5%	18	27.7%
1.0%	38	58.5%
1.5%	3	4.6%
2% Or More	6	9.2%
	65	100%

Through the question presented, the workability can be increased by adding or increasing the percentage of water, as it was noted through the questionnaire that 27.7% voted that they add water by 5% to increase the workability of concrete, while 58.5% voted that they add water. 1% to increase the workability of concrete, 4.6% and 9.2% voted that they add 1.5% and more than 2% sequentially, and through the

results, we notice that the majority of votes agree that they add no more than 1% to increase the operability, which gives a good indication because the high level of water can reduce the resistance of the discipline to the concrete as a result of the evaporation of water later, leaving voids.

3. For how much time workers use vibrator to get the proper and standard compaction of concrete for good quality?

Answer	Frequencies	Percentage
2mint	30	46.2%
3mint	26	40.0%
More Than 3mint	9	13.8%
	65	100%

The use of vibrators for concrete is very important for projects, as it contributes to the disposal of air bubbles and obtaining high resistance, but the increase in the use of vibrators can cause isolation for concrete, through the questionnaire it was found that 46.2% use the vibrator for 2 minutes, 40% use it for 3 minutes and 13.8% use it for more than 3 minutes, and through the impossible results, it shows the quality and accuracy in using the tools to apply the best quality in projects, and the vibrator is one of these tools.

4. When scheduling and monitoring is done at site?

Answer	Frequencies	Percentage
At Start Of Activity	40	61.5%
In The Mid Of Activity	3	4.6%
At The End Of Activity	19	29.2%
Not Done	3	4.6%
	65	100%

The scheduling step is very important, as it is possible to predict the duration of each work activity and also to anticipate and solve errors and obstacles before starting the activity, and through the collected votes we note that 60% of the votes collected in the questionnaire voted that scheduling should be at the beginning of the activity to alert the progress of work and try to solve problems, while 4.6% voted that they

schedule activities in the middle of each activity, and 29.2% respond at the end of the activity so that the duration is accurate and through which the prediction in the next paragraphs and only 6% do not schedule, but there is no doubt that scheduling is important from the information and expectations you provide for the progress of each activity.

5. Which planning software are you using?

Answer	Frequencies	Percentage
P6	6	9.2%
Ms Project	50	76.9%
Cpm	3	4.6%
Pert	6	9.2%
	65	100%

Scheduling programs are very important programs through which they draw activities and durations in addition to scheduling for each project activity. The programs vary according to the manufacturer, but they are often similar in content, and the most prominent of these programs are MS project, p6, CPM, PERT and Based on the results of the survey, it was found that 76.9% use MS PROJECT and the rest of the programs combined in 23.1%.

6. What % age of second class brick you use in your construction with respect to first class bricks?

Answer	Frequencies	Percentage
20%	25	38.5%
30%	28	43.1%
50 %	9	13.8%
More Than 50%	3	4.6%
	65	100%

The bricks of class A are characterized by their resistance to the bearing necessity in addition to bearing the loads, while the class B is characterized by its resistance to the loads, but the resistance to weather conditions is low, so it is used in the internal bearing partitions, and by voting in the questionnaire the results were as follows, 38.5% use the class B with class B by 20% and 43.1% use it by 30%, and 13.8% by

5% and 4.6% by more than 50%. We note through the results presented above that 80% use bricks of class B with a percentage not less than 30%.

7. What is the water absorption of bricks that you have used at particular project site?

Answer	Frequencies	Percentage
20%	18	27.7%
22%	26	40.0%
24%	6	9.2%
Test Not Performed	15	23.1%
	65	100%

The absorption is one from important tests for brick, if the salts are leaving spaces in the brick that reduced the quality, the higher the absorption ratio decreased the quality of the bricks, through the questionnaire found that 27.7% use the bricks by a 20% and 40% suction net up 22% and 9.2% suction absorption 24% in good and 23.1% of which do not require them to examine, we notice that 76.9% use the brick by absorption not more than 24%.

8. If quality control practice is carried out at your site, then what is the tolerance limit from standards?

Answer	Frequencies	Percentage
5%	12	18.5%
10%	26	40.0%
More Stringent Than Standards	18	27.7%
More Than 10	9	13.8%
	65	100%

Through the question presented the vote is that the tolerance of the specifications is as follows: 18.5% voted that the tolerance is 5% and 40% voted that it is 10%, while 27.7% voted that it is More explicit than the specifications, while 13.8% voted that it is more than 10%, which gives a good indication of the tolerance in the specifications not more than 10%.

9. At your project what is the % age of soil compaction you get?

Answer	Frequencies	Percentage
95%	21	32.3%
90%	38	58.5%
85%	6	9.2%
	65	100%

The compaction resistance of the soil is very important as it contributes to the correct distribution of loads on the soil, and the compaction ratio of field soil varies due to soil compaction under standard conditions. Through the questionnaire, it was noted that 32.3% use a resistance of 95% in standard conditions, which is very high, while 58.5% voted that they use 90% compaction under standard conditions, while 9.2% with 85% ratio, which gives a good indication of the keenness to obtain high soil resistance and therefore excellent quality.

10. Is soil investigation test is carried out for your site?

Answer	Frequencies	Percentage
No	6	9.2%
Yes	59	90.8%
	65	100%

Soil investigations are very important for projects, as they show soil resistance, high groundwater level, soil type and extract, specific weight, density and many other characteristics of the soil. Therefore, it is important to take a soil investigation examination before starting the project, and through voting, it was found 90.8% of the projects conduct soil investigations before starting the project, while 9.2% do not take soil investigations, and these results give a good indication of the quality of work.

11. After how many days you carry out test on concrete?

Answer	Frequencies	Percentage
7 Days	24	36.9%
14 Days	25	38.5%
28 Days	16	24.6%
	65	100%

The examination of resistance of the grinding of the tests of the important task for concrete and in the 39 business schedules (7, 14, 28) day, through the questionnaire, and that 36.9% will check the 7 day and 38.5% in 14 days, while 24.6% 28 days, the presence of concrete checking with the same indicator of the quality of the work.

12. For how much time concrete batching plant revolve for concrete production?

Answer	Frequencies	Percentage
1 Mint	6	9.2%
2 mint	27	41.5%
3 mint	20	30.8%
4 mint	12	18.5%
	65	100%

The mixing time is very important for concrete, as the short mixing time in the production of concrete makes the components not homogeneous, and the mixing of the long time leads to cracking and separation of concrete parts. While 41.5% mix for a time capacity of 2 minutes, 30.8 mix for a time of capacity of 3 minutes, while 18.5% mix for a time of 4 minutes, which is a big time. We note that 72.3% of those who use it with a time of 2-3 minutes, which is an indicator and time good for concrete.

13. What % age of tensile strength (fc') of concrete you get at your project?

Answer	Frequencies	Percentage
8% Of Fc'	3	4.6%
10% Of Fc'	22	33.8%
12% Of Fc'	16	24.6%
No Test	24	36.9%
	65	100%

As it is known that concrete's tensile strength is often weak, while its compressive strength is high, unlike reinforcing steel, which has low compressive strength while its tensile strength is high. In some projects, tensile strength is calculated as a percentage relative to the compressive strength of concrete. The questionnaire included the following: 4.6% have a tensile test, 8% have a compression test, 33.8%

have a 10% test, 24.6% have a 12% test, and 36.9% do not do a tensile test for concrete.

14. What type of steel bar is used at your site?

Answer	Frequencies	Percentage
Grade 40 Hot Rolled	12	18.5%
Grade 60 Hot Rolled	43	66.2%
Grade 40 Cold Twisted	4	6.2%
Grade 60 Cold Twisted	6	9.2%
	65	100%

The type of steel is also important in the formation of structures, and the results show the type of steel used in projects. The results showed that 18.5% use grade 40 hot rolled, 66.2% use grade 60 hot rolled, while 6.2% grade 40 cold twisted and 9.2% grade 60 cold twisted, which is a good indication that the iron used is of high resistance

15. Which quality of mixing water you used at your site?

Answer	Frequencies	Percentage
Tap Water	40	61.5%
Distilled Water	9	13.8%
Any Quality	10	15.4%
Never Checked Quality	6	9.2%
	65	100%

The quality of the water is also important, as the presence of salts in the water causes cracks and weakness in the concrete. Through the questionnaire, 61.5% of the water is tap water, and as it is known, the tap water goes through treatment stages in which the impurities are removed before pumping, and 13.8% use distilled water, which is of high quality, while 15.4% use water of any quality and 9.2% do not check the quality of the water, so it can be said that water of high quality and free of impurities is used by 75.3% of the projects and this is an indicator of quality

According to the results of the questionnaire presented above and taking into account the techniques and tools used in the quality management system and the percentages

of their use in the projects, it was found that the projects from which the questionnaire was taken work with **84.70%** of the quality management system, which is a very good indicator and it is possible to work on developing projects and making them conform totally for the system.

The researcher notes that the percentages obtained from the questionnaire are very close to the percentages obtained from project managers, and this shows and confirms that the views of project managers that the system does not need to change, but rather needs to develop, update and address the weaknesses in it instead of working on a new system.

#### **4.4 The Concept of Quality**

The following are the respondents' summarized responses to the concept of quality:

- a) Documents and customer expectations are linked to quality.
- b) The process that leads to a finished product is a factor in its quality.
- c) The end product is influenced by the document quality.

The project manager describes the fact that quality is more than the end product: "It's important to get a good end product, but also the way in which you get it." It is being developed by another project manager who describes: "First of all, everyone thinks of a building as physical, how well it is built. Then there is a possibility to deal with it purely administratively. And how to control from the outside and what the end product will be.

A project manager goes on to describe quality as a combination: "Quality means, of course, leaving behind a product that the consumer likes and that one also likes." Another project manager goes on to say that quality is defined as "what we deliver is translated into action becomes". You can view this as a delivery on time at the correct price relative to the document.

In the project manager's view, quality is also related to documents, which is described by the statement "documents must be better designed to produce a better end product".

## 4.5 Requirements

Various methods are used to identify and verify the requirements:

- a) A control plan is used to identify control points.
- b) Bring in inspectors early on to double-check the requirements.

The tests to be performed are specified on the basis of the test plan and documents. The project managers explain how they create the control plans: "We start with the control plan drawn up by the control manager." All requirements resulting from project-based learning must be verified. This is the basic project template. Therefore, a control program is installed for all control processes ". " The controls are primarily based on experience, "says another project manager. Another project manager explains it like this:" Each project is unique and takes a bit of the previous one. and look at other new situations. "

Five project managers indicated that they invited or intend to invite inspectors in advance to ensure requirements are met. "We started from the beginning to include all the inspectors," says the project manager. Then go back to the beginning of the project and fix the bugs. " Inspectors then help reach an agreement on the project and determine if the work meets the required standards.

## 4.6 Quality Management

According to the respondents, quality management is effective and can be enhanced in the following ways:

- a. Overall, quality control is works well.
- b. Increase the participation of professionals.
- c. Making a work plan.
- d. Motivation to do an excellent work.
- e. The organizational structure with regard to quality.
- f. Responsibilities are distributed throughout the production process.

The vast majority of project managers believe that quality control is effective. Several elements influence how high-quality work is performed. "There are aids for

it to be good," a project management says, "but it's always an issue of resources, staffing, and competency."

Skilled workers can return to quality management by assuming more responsibilities. "The good thing about audits is that they feel a little more responsible and therefore more involved," explains the project manager.

The planning of the work is essential to achieving a high level of quality. "Planning is important for good quality," says project manager. Start-up meetings, morning meetings, and work preparations are all vital parts of quality work, according to various project managers. According to a project manager, planning can also help build consensus on quality: "If a client can express their wishes for all of them, they all receive the same information about where the benchmark is in the project."

Respondents describe and highlight variables that can contribute to a higher level of motivation to complete a quality task. "Reward and pay attention to colleagues who have done a fantastic job," says the project manager. for leaving positive feedback and not suggesting anything. "The environment is important in the workplace," explains another project manager. In a culture that reflects quality and concern for quality, motivation is based on many elements, as the project manager says: "By simplifying the task, one becomes more motivated and motivated when everything is going well. "

All project managers recognize that quality is their primary responsibility. "Everyone is obliged to maintain good quality," says the project manager at the same time. Another project manager argues that responsibilities are divided due to lack of resources: "The organizational structure works well, but it is also a resource problem." It is difficult when you need four leaders and there are only two". The human factor can cause problems in the organizational structure. The project manager emphasizes: "Personal chemistry should not be overlooked. It is very important to find a group that can work well together. Sometimes you may need to transform an organization and you shouldn't be afraid to change your mind.

The majority of respondents consider a clear distribution of tasks essential to monitor all project work.

## 4.7 Standardization

In the interviews, respondents identified the following examples of repetitive work steps:

- a. Get findings from others who have had similar experiences.
- b. Professionals would be included.
- c. To carry out checks in a uniform manner.
- d. Appropriate use of skills

There is no one-size-fits-all approach to providing feedback on an experience. "It's difficult since every workplace is different," a project manager explains. "It is difficult because we offer a prototype for each project," another project manager confirms. It is much easier to improve a thing if you can repeat it." "We work with the top builders in the world," says a project manager. To avoid having to recreate the wheel, you put up various job preparations there. We share both positive and negative experiences with each other there." An internal network for feedback on experience is the world's best builder. Another project leader mentions that he has an experience list that he uses to gain experience for future projects. "The list of experiences carries over to the next project, where it is checked before the start of the project."

Each participant can share their knowledge and experiences, which can be taken from previous projects. People who consider themselves multi-project managers have a lot of experience. "In this project we have two assistants and a carpenter who have participated in previous similar projects," explains the project manager, explaining how they transmit the experience through professionals. It is advisable to involve them in the project from the beginning so that they can apply their experience while studying drawings and details. It is not a document, but it is a good way to use the experience". A project manager believes that it is more practical than theoretical to involve professionals in the process from the beginning. Another project manager emphasizes the importance of professional worker competence: "professional worker's early involvement is important so they know how we should go through the motions."

A project manager suggests that mentors who are about to retire become mentors to young, inexperienced colleagues: " Nobody wants to become a mentor after 65 years, but maybe it would be great if someone asked you earlier." The vast majority of project managers are audited. "We want to work with a professional to test tablets," the project manager tries to prove with a professional. This should be established if the review supervisor needs time and cannot always work on time. "

Regarding the question of how the competence of the person to take the examination is ensured, it is stated that the decision rests largely with the person conducting the examination. "If you don't have this competence, you can ask," says the project manager. The party leader is also noted to have the last word: "The party leader must ensure that everyone has the necessary skills." For example, e-learning can be used to expand it." "You don't hire young people or new people to carry out inspections, you choose employees with knowledge," explains the project manager.

#### **4.8 Digitization**

Respondents say they use digital tools as part of their work such as:

- Image documentation.
- BIM.

According to the project manager, self-control can be linked to digital tools. "Self-control must be linked to a sequence of images," he says. This is a good way to show that it is. "With digital tools, images can be linked for self-monitoring.

BIM360, a cloud-based digital information management service, is considered an effective auditing tool. The software allows you to update the driver regularly. "BIM can be constantly updated," explains the project manager, "this makes it easy to see what the respective skilled workers and engineers have achieved." Before BIM, you had to rush documentation, which meant testing was often delayed and information completed too late can be collected on the same platform as BIM.

#### **4.9 Development**

Suggestions were made for the development of quality work in the following areas:

- Education
- Fixed routines.

Two project managers believe that people with limited experience may need guidance on what to look for. "As a recent graduate, I have a hard time figuring out what to control," says the project manager, "but I don't know how to solve this problem, maybe education." Vocational training is also a way to increase quality: "Train specialists from the beginning to do the right thing," says the project manager.

Furthermore, a project manager also explains: "I try to follow the established processes so that everyone knows how we work with quality". It is important that everyone knows the steps and what the process looks like so that more than one person knows how it works.

#### 4.9.1 Frame work develop for quality control in project construction

A formwork for controlling construction projects has been developed on the basis of a general questionnaire format and a project manager format, as shown in Table 4.5.

The above framework is based on according to the various project constructions and their perspective with the interview and the project manager question template, finally a procedure to developed the framework to achieve construction project quality.

**Table 4.4:** Frame Work for the Quality Control

Effective factor for Project management to control quality of a Construction Project					
Design Stage		Monitoring Stage		Execution Stage	
1	Proper Design Selection	1	Monitoring and Evaluation	1	% Saving of Money
2	Design Concept	2	Project Updating Tool	2	Work abilities of Material
3	Layout of design	3	Investigation of Material	3	Variation of Timeline
4	Stability & Information System	4	Health & safety management	4	Ensure Quality of material Usage

**Table 4.4:** Continue

Effective factor for Project management to control quality of a Construction Project						
Design Stage		Monitoring Stage			Execution Stage	
5	Design Revision before implementation	5	Employees Motivation		5	Allowed Quality Control Deviation
6	Tender Prices	6	Controlling & Monitoring		6	Followed Planning Sequences
7	Research and development	7	Internal & External stakeholder management		7	Construction Method of Achieving Quality
					8	Human Resource & Financial Resources

## **5. ANALYSIS**

### **5.1 General**

In the analysis, the answers from the respondents are linked to the theoretical background.

### **5.2 Concept of Quality**

The quality is a subjective concept, a connection between expectations and the work performed. This can be compared with the respondents' answers where they believe that the quality is linked to the documents and thus the customer's requirements and the legal requirements. However, customer satisfaction is not linked to the documents. If the customer does not know what it has ordered or defined in the documents, the quality can be perceived as substandard by the customer, even though the requirements are met.

### **5.3 Requirements**

The statutory inspections must be carried. The other controls that the project managers take up are required by agreement between the customer and the contractor. As describes, controls are required according to the agreements signed between the contractor and the customer. The controls are designed according to the project managers in different ways. Partly through experience, partly by reusing controls from previous projects. Another project manager emphasizes that each project is unique and that new controls must therefore be established for each project. It is not substantiated by ISO 9001 which states that every repetitive process must be identified. The controls can be seen as repetitive steps.

### **5.4 Quality Management**

The project managers believe that the quality work generally works well. This in itself is positive but believes that the organization must work towards continuous

improvement in order to develop. Leadership is an essential part of the improvement process. If the work is to be improved in an effective way, those responsible for the management, which includes the project managers, must be motivated to improve the process. Those involved must see the need for change for a change to be possible.

Including the professional workers in the controls increases the responsibility for the quality work, according to a project manager. This is supported by Bergman who believe that if everyone is included in the quality work, a greater interest in the end product is created. It increases the understanding of the project and gives individuals the opportunity to develop their own work by evaluating the results they have produced. It will then also be a standardizing development process of one's own work.

However, the function of controls as a quality-enhancing factor is questioned by who believes that controls on work already performed can damage motivation and shift responsibility from the performer to the controller. This means that inspections of work performed are not a way to increase the quality of the project as a whole. They can instead be seen as a tool that will create security for the customer. It is then important to convey its purpose to those who establish the controls.

A project manager explains how leadership plays a significant role in the motivation to perform work with quality awareness. The person gives examples of how praise and the simplification of tasks create motivation. The parallel between leadership and quality work is also drawn who believe that leadership is the key to motivation. In order to work towards a better end product with a qualitative way of working, the entire workplace must be motivated. Describes how the culture with quality in focus must exist in order to achieve a good result.

The quality must thus not come from above but be built into the product throughout the process. It also describes a project manager who believes that it is important to work out a quality culture in the workplace.

## **5.5 Standardization**

The method of experience feedback varies between the different project managers. Some state that they do not work with the experience feedback; others share their experiences through special meetings. Sharing experiences after and during projects is supported in Deming's improvement cycle for development. According to the model, the work after execution must be analyzed and developed. In order for everyone to be able to share the experiences in an effective way, it is essential that there is a standard for the feedback of experience. Describe how the documentation must be standardized for the information flows to be efficient. Interactive tools can be part of that way of working.

Four project managers believe that quality can be raised with the help of a consensus on the project and a more inclusive approach to the professionals. Several concrete examples are given, such as the early inclusion of experienced professionals in the process of studying drawings.

This view of an inclusive approach is supported in theories of leadership with an understanding of employees and a belief in their knowledge. They believe that it strengthens professional pride and the will to develop and improve working methods. The consensus in the projects thus leads to an increased awareness of quality.

A project manager raises the issue of retirements and suggests that those close to retirement could work as mentors for the younger ones. It is a way to convey their experience before they disappear from the company. It takes support in cycle as a mentorship can standardize the feedback of experience. As write, it is about adapting a quality process so that it suits the company.

## **5.6 Digitization**

The project managers who work with digital tools have a positive view of the way they work. Digital tools are said to be able to simplify and clarify controls and documentation. In this way, make the work more efficient. This is supported by who believes that digital tools can provide a more orderly structure in the documentation. It also enables more actors to collaborate and gain access to the same information at the same time. However, the educating of users to be able to apply BIM in a project is very important.

By using BIM, information can be linked to different building components. According to a project manager, it enables images to be linked to the controls, which is highlighted as an example of how an added value of the controls would be created.

## **5.6 Development**

A project manager believes that increased use of fixed routines in quality work can lead to everyone knowing which steps to carry out. This is supported who believe that quality comes from routines and experience. It is part of including the professionals more in the quality work.



## **6. DISCUSSION**

### **6.1 General**

The chapter discusses the results and the method in relation to the theories that exist within the subject.

### **6.2 Theory and Method Discussion**

Quality management is a broad concept and the methods for quality management are largely based on Deming's theories, on which ISO 9001, which is a global certification system, is also based. The work therefore concerns few theories on quality management. If more theories had been used, a broader picture of quality management would have been given, but since TQM is the accepted system in the industry, this theory was chosen.

The methods used in the work were literature study and an interview with a twenty-six project manager and a questionnaire survey to a sixty-five. Using semi-structured interviews provided an opportunity for dialogue and development of the answers.

The discussion is influenced by the interviewers' knowledge of the subject. More knowledge can create a better dialogue. The way the questions are asked also affects how the question is perceived, which affects the respondents' answers. The interviews had to be conducted via digital communication. During the interviews, some of the interviewers used the camera to increase transparency and open the dialogue. About one-third of respondents used their camera. The digital communication was perceived to impair the interaction between the respondent and the interviewers.

Reliability at work was low as few interviews were conducted and then more interviews were conducted in many companies, as well as interviews with more professional groups targeted in this study, and this will make the results more generalizable and more reliable

The design of the interview questions provided answers about quality management and created a picture of how quality management works, which provides good validity. To further increase the validity, an even better subject background would be needed. With a deeper understanding of the subject, the questions could be further developed. For example, the impact of the contract form on the quality work could be discussed with the respondents.

To increase the quality of the work, the interviews would be supplemented with another method. The purpose was to visit workplaces to carry out observations on how the quality work worked in practice. However, it was not possible to do this at an early stage due to the restrictions due to COVID-19 so more interviews were conducted in different regions to get a more accurate result.

### **6.3 Results Discussion**

During the interviews, it became clear that the project managers believe that the quality systems works well and the results of the survey supported the opinions of the project managers who participated in the interviews. The starting point is that the working method does not need to be changed to increase the quality but to develop the existing working method. Several suggestions are given from the project managers about what could be improved. It can also be linked to who believes that it can have greater effects to develop the existing quality system instead of introducing a new way of working.

The results show that the feedback of experience lacks continuity in the interviewees. It is emphasized that each project is unique and that it is therefore problematic to work with experience feedback. Deming's improvement cycle is based on the work being evaluated and studied in order to be able to improve. It is therefore essential to work with the feedback of experience in order to be able to develop the next project. Due to the fact that new requirements are set for each project, the process looks different, but by identifying the requirements that are the same, the process can be done with standardized. It can be linked to ISO 9001 which contains requirements that every repetitive process must be standardized. It is several project managers who state that they work with the experience feedback, but everyone within the company needs to work with it in a similar way for the experience feedback to be effective.

By bringing in inspectors at an early stage, several project managers state that they raise the quality of the work. The inspectors are said to be able to detect deficiencies early in the project and measures can then be taken immediately. The working method can be linked to ISO 9001 which describes how the customer's needs are to be analyzed.

The inspectors act as verification that the requirements are met. It is essential for repetitive steps to do the right thing from the beginning, as consequent errors can otherwise occur.

The self-checks function as a legal security for the client and provide a guarantee that the work has been carried out correctly. However, describes how controls can lower the motivation of those who perform the work. He explains that the control shifts the responsibility from the person performing the work to the person controlling. The controls should thus not function as a tool for quality assurance. However, it can be interpreted that ISO 9001 requires the controls to learn from previous mistakes. A clarification of the function of the controls is important and, as a project manager states, the controls can be improved with the help of image documentation. The inspection can be seen as a verification instead of an inspection and thereby reduce the risk that the motivation of the professional workers will be damaged when their work is inspected. Even letting the professionals carry out the checks can increase motivation. If the person performing the work checks the same, the responsibility remains with the contractor instead of being transferred to the inspector.

Questions related to digitization were not asked specifically during the interview, but examples were highlighted of how it affected the quality work. Digitization meant BIM360. In order to introduce BIM in the projects, according to training for the application to take place effectively. There are also economic benefits to using the entire production chain as an information platform. As a project manager explains, BIM can clarify information from those involved in the project and thus simplify, for example, the controls. However, it requires that everyone who participates in the project uses BIM in order for the information to be used effectively.

No general conclusions can be drawn for this type of qualitative survey for the entire occupational category or industry. However, the conclusions can be interpreted as a reflection of the industry as the requirements that the contractors must meet are the same throughout the industry. The result only reflects the project managers' views on

quality work and no other professional categories. For example, including the professionals' views on inspections could have given a different approach to who should carry out the inspections.



## **7. CONCLUSIONS**

### **7.1 General**

The chapter addresses the development opportunities that exist in quality management and proposals for further studies.

### **7.2 Development Opportunities**

From the results, a number of points have been highlighted that can improve and develop the quality work. By deepening the work within these points, the end product can be improved.

For increased quality, the following points are required:

#### **7.2.1 Standardization**

Creating new control plans for each project makes each project unique. By creating, for example, templates for controls, the work can be standardized and the control points can thus be improved in a more consistent way. By seeing similarities between the projects instead of differences, the processes can be developed.

The experiences within the organization can be conveyed in a more consistent way. In order to be able to improve the quality work, the experiences must be utilized and returned to the organization. The working method with, for example, experience lists or using experienced staff with the right skills can contribute to a better feedback of experience.

#### **7.2.2 Inspections at an early stage**

By using inspectors at an early stage, a standard for quality can be set. The inspectors become a way to clearly convey the customer's expectations of the project. The working method means that errors can be detected early. In this way, it is avoided that errors are built in and that errors are repeated at several steps.

### **7.2.3 Leadership**

Participation and consensus in the project contribute to increased motivation. The role of the leader is of great importance for participation in the quality work. By showing trust and giving encouragement, the leader can strengthen motivation to perform the work with good quality. Including the professionals early in the projects and using their skills can thus increase the quality of the projects. The professional workers can then also be used to review documents. It is a way to avoid and reduce the errors that come with the actions.

The function of the controls in the construction sector should be clarified. Controls can reduce responsibility and lower the motivation of professionals. Checking the work performed also means that the work may need to be adjusted afterwards. Redoing work can lower motivation. Instead of inspections, the work can be documented to a greater extent. It then becomes verification that the work has been performed correctly instead of a check.

### **7.2.4 Digital tools**

The difficulties of implementing industrial quality management tools in the construction sector are discussed. The production method used to produce construction works is far from the controlled industry such as car manufacturing. However, the goals of a project must be clear. This is done through standardization were, among other things, digital tools such as BIM can be a solution. In order to be able to introduce a standard, everyone must be motivated and willing to change their way of working, perhaps fundamentally.

## **7.3 Suggestions for Further Studies**

Based on the conclusions drawn in the work, proposals are presented here on what can be studied further to further develop methods and working methods:

- a. Several respondents view the inclusion of inspectors positively at an early stage. How the inspectors should be included and what effects it has can be studied in more depth.
- b. How the controls can be standardized for reuse in more projects should be investigated further.

- c. The importance of leadership for quality can be studied more deeply.
- d. The impact of the contract form and the form of collaboration on the quality of the end product.
- e. What effects digital tools have when they are used as support in the entire process of a project?



## REFERENCES

- Beatham, S., Anumba, C., Thorpe, T. and Hedges, I.,** (2004). KPIs: a critical appraisal of their use in construction. *Benchmarking: an international journal*.
- Besterfield, D.H.,** (2004). *Quality control*. Pearson Education India.
- Bonanno, G.A.,** (2004). Loss, trauma, and human resilience: Have we underestimated the human capacity to thrive after extremely aversive events?. *American psychologist*, 59(1), p.20.
- Butnaru, G.I. and Miller, A.,** (2012). Conceptual approaches on quality and theory of tourism services. *Procedia Economics and Finance*, 3, pp.375-380.
- Carlsson Sandelin, E. and Mattsson, M.,** (2019). Kvalitetssäkring inom byggbranschen: Entreprenörens egenkontroll i produktion.
- Chiarini, A.,** (2017). Risk-based thinking according to **ISO 9001: 2015** standard and the risk sources European manufacturing SMEs intend to manage. *The TQM Journal*.
- Chudley, R. and Greeno, R.,** (2013). *Building construction handbook*. Routledge.
- de Valence, G.,** (2012). A theory of construction management? *Construction Economics and Building*, 12(3), pp.95-100.
- Earnshaw, V.A., Reisner, S.L., Menino, D.D., Poteat, V.P., Bogart, L.M., Barnes, T.N. and Schuster, M.A.,** (2018). Stigma-based bullying interventions: A systematic review. *Developmental Review*, 48, pp.178-200.
- Edum-Fotwe, F.T. and McCaffer, R.,** (2000). Developing project management competency: perspectives from the construction industry. *International journal of project management*, 18(2), pp.111-124.
- Ekholm, A. and Tarandi, V.,** (2000). Application of IFC in Sweden—phase 2. Final report. The Swedish Building Centre Systematics, Stockholm.
- Endris, o.,** (2020). Professional ethics in the ethiopian construction industry in the case of bahir dar city public building project (doctoral dissertation).
- Eriksson CG** (1988). Focus groups and other methods for increased effectiveness of community intervention – a review. *Scand J Prim Health Care Suppl*; 1:73–80.
- Forcada Matheu, N.,** (2005). Life cycle document management system for construction. Universitat Politècnica de Catalunya.
- Gann, D.M. and Salter, A.J.,** (2000). Innovation in project-based, service-enhanced firms: the construction of complex products and systems. *Research policy*, 29(7-8), pp.955-972.

- Gerardo Viera** (September 2008). "What Is Construction Project Management?". PM Hut. Archived from the original on 2010-04-20. Retrieved 2010-07-04.
- Goldstock, R.**, (1991). Corruption and Racketeering in the New York City Construction Industry: Final Report to Governor Mario M. Cuomo. NYU Press.
- Harrington, H. J., Voehl, F. and Wiggin, H.** (2012) 'Applying TQM to the construction industry', *The TQM Journal*, 24(4), pp. 352-362.
- Igwe, C., Hammad, A. and Nasiri, F.**, (2020). Influence of lean construction wastes on the transformation-flow-value process of construction. *International Journal of Construction Management*, pp.1-7.
- Ingelsson, P., Bäckström, I. and Snyder, K.**, (2018). Strengthening quality culture in private sector and health care. *Leadership in Health Services*.
- Kartha, C.P.**, (2004). A comparison of ISO 9000: 2000 quality system standards, QS9000, ISO/TS 16949 and Baldrige criteria. *The TQM magazine*.
- Koseoglu, O., Keskin, B. and Ozorhon, B.**, (2019). Challenges and enablers in BIM-enabled digital transformation in mega projects: The Istanbul new airport project case study. *Buildings*, 9(5), p.115.
- Lukichev, S. and Romanovich, M.**, (2016). The quality management system as a key factor for sustainable development of the construction companies. *Procedia Engineering*, 165, pp.1717-1721.
- Magar, V.M. and Shinde, V.B.**, (2014). Application of 7 quality control (7 QC) tools for continuous improvement of manufacturing processes. *International Journal of Engineering Research and General Science*, 2(4), pp.364-371.
- Nagel, D.**, (2018). Transatlantic Integration: The TTIP under Scrutiny. *Journal of Modern Accounting and Auditing*, 14(9), pp.466-511.
- Najafi, M.**, (2010). *Trenchless technology piping: Installation and inspection*. McGraw-Hill Education.
- P. Pöyhönen, J-K. Kajander, M. Sivunen**, Innovation Management System for Construction Companies. *Creative Construction Conference 2016*, Budapest.
- Révay, Z. and Kennedy, G.**, (2012). Application of the k0 method in neutron activation analysis and in prompt gamma activation analysis. *Radiochimica Acta*, 100(8-9), pp.687-698.
- Saqib, M., Farooqui, R.U. and Lodi, S.H.**, (2008), August. Assessment of critical success factors for construction projects in Pakistan. In *First International Conference on Construction in Developing Countries* (pp. 392-404).
- Talha, M.**, (2004). Total quality management (TQM): an overview. *The bottom line*.
- Waldman, D.A.**, (1994). The contributions of total quality management to a theory of work performance. *Academy of Management review*, 19(3), pp.510-536.

## APPENDIX

### Appendix A: Interview Questions Format for Project managers

<b>Interview questions for Production Managers</b>	
1	Age: _____ Gender: _____
<b>Briefly about the participant (background facts)</b>	
2	What is your job? _____
3	How many years in the industry? _____
4	What is your background in the industry? _____
<b>Questions:</b>	
1	<b>How would you define quality?</b>
Ans:	_____
2	<b>How do you distinguish between error and cheating?</b>
a.	What is a cheat? _____
Ans:	_____
b.	What is a fault? _____
Ans:	_____
c.	Do you distinguish between handling errors and cheating? _____
Ans:	_____
3	<b>How do you think the quality control during production works?</b>
a.	Seen from the design to the inspection. _____
Ans:	_____
b.	In such cases, what could the industry do differently? _____
Ans:	_____
4	<b>How do you identify which checks to perform when a project starts?</b>
a.	How do you know what to check? _____
Ans:	_____
b.	What are the requirements? _____

Ans:	
c.	How do you know what should be in a self-check?
5	<b>How do you work with quality in the production stage, then with regard to the work performed?</b>
a.	Are there other ways than controls that can increase the quality of the project?
Ans:	
b.	Are the contractors aware of how the quality work works?
Ans:	
c.	How do you work to ensure that everyone is motivated to carry out the work with high quality?
Ans:	
6	<b>How do you ensure that errors are not repeated in the project and in the next project?</b>
a.	How do you work to include the experience feedback to avoid repeated mistakes?
Ans:	
b.	How do you document the work you do with regard to quality?
Ans:	
7	<b>How do you think organizational structures with regard to quality work?</b>
a.	What does the division of responsibilities look like?
Ans:	
b.	Are there ready-made templates for self-inspection?
Ans:	
c.	Can you do something different?
Ans:	
8	<b>How do you ensure that the division of responsibilities of the quality work is clear throughout the process?</b>
a.	Example: how a certain work step that contains important controls actually has someone controlling them.
Ans:	

b.	That all steps to be checked are actually checked.
Ans:	
9	<b>Who performs your checks of various work steps?</b>
a.	How do you ensure that the person inspecting has the skills required to carry out an inspection?
Ans:	
b.	Do you bring in external experts?
Ans:	
c.	How do you ensure that the “minimum approved level” is equally independent of who performs the check?
Ans:	
10	<b>How do you think it is possible to ensure that the work is carried out in the right way with the right quality?</b>
a.	A development, for example more controls, additional documentation or greater personal responsibility, training?
Ans:	
	<b>Do you have anything more to add</b>

## Appendix B: Questionnaire Format

<b>Questionnaire Survey</b>		
I am investigating the "Quality Control Culture Assessment of Construction Projects in Iraq". Your good answer		
Following questions will be much appreciated.		
Age:	Gender:	
<b>Section-1: Briefly about the participant (background facts)</b>		
1	Please select your position in the organization.	(a) Director (b) Project Manager (c) Site Engineer (d) Quality Control Engineer (e) Other
2	Please select the type of your organization.	(a) Client (b) Contractor (c) Consultant
3	Please select your qualification level.	(a) PhD (b) Masters (c) BSc (d) Diploma
4	Please select in years your overall experience within the construction industry?	(a) <5 years (b) 5-10 years (c) >10 years (d) >20 years
5	Please select the number of years' you have been employed by your current company?	(a) <5 years (b) 5-10 years (c) >10years (d) >20 years
<b>Section-2: Common Quality Control Practices in Construction Sector</b>		
6	Have you used any form of quality management system in the construction industry?	(a) Yes (b) No
7	Have you ever been communicated or advised about quality management from senior management in your current project?	(a) Yes (b) No
8	Are you currently using any of these quality management systems on your project?	(a) ISO 9000 (b) Custom (c) Client (d) Checklist (e) Specialist Sub Contractor System (f) None
9	Do you use any of the following activities in order to ensure quality in your current project?	(a) Quality Planning (b) Pre-Established Criteria (c) Predefined Personnel Authority (d) Quality Control Technique (e) Snagging (f) All of the above (g) None of the above
10	Do you use a quality register on site?	(a) Weekly (b) Fortnightly (c) Monthly (d) Sporadically (e) Never
11	In direct comparison to that of health and safety (H&S) on site; please give your opinion on the importance of quality management in your construction project.	(a) More (b) Same (c) Less
12	How do you rate the attention of your company gives to quality management in comparison to that of H&S?	(a) More (b) Same (c) Less

13	Do you think each site should have a quality manager responsible for implementing quality plans and checklists?	(a) Yes (b) No
14	Do you feel that a quality management system is a necessity for the site team to deliver a project with zero defects?	(a) Strongly Agree (b) Agree (c) Neutral (d) Disagree (e) Strongly Disagree
15	In a typical working week; do you feel that spending time to ensure quality is important?	(a) Strongly Agree (b) Agree (c) Neutral (d) Disagree (e) Strongly Disagree
16	Have you ever received training in any form of quality management system	(a) Yes (b) No
17	Do you feel site managers need to be trained in quality management skills?	(a) Yes (b) No
18	Would you be spending more time to achieve zero defects if there were incentives provided to you?	(a) Yes (b) No
19	Do you agree quality management systems help reduce defective work and the number of snag corrections in your current project?	(a) Yes (b) No
<b>Section-3: Experience of Respondents in Quality Management System</b>		
21	How much money may be saved in the building industry if quality control management is used?	(a) 5% (b) 10% (c) 15% (d) more than 15%
22	To get excessive workability of concrete how much extra water workers are adding during pouring of concrete?	(a) 0.5% (b) 1.0% (c) 1.5% (d) 2% or more
23	How long do workers use a vibrator to ensure proper and consistent concrete compaction for good quality?	(a) 2mint (b) 3mint (c) more than 3mint (d) No vibration
24	When scheduling and monitoring is done at site?	(a) At start of activity (b) In the mid of Activity (c) At the end of activity (d) Not done
25	Which planning software are you using?	(a) P6 (b) MS Project (c) CPM (d) PERT (e) TILOS
26	What % age of second class brick you use in your construction with respect to first class bricks?	(a) 20% (b) 30% (c) 50% (d) More than 50%
27	What is the water absorption of bricks that you have used at particular project site?	(a) 20% (b) 22% (c) 24% (d) Test not performed
28	What is the tolerance limit from standards if quality control is applied at your site?	(a) 5% (b) 10% (c) More stringent than standards (d) more than 10
29	At your project what is the % age of soil compaction you get?	(a) 95% (b) 90% (c) 85% (d) less than 85%
30	Is soil investigation test is carried out for your site?	(a) Yes (b) No
30	After how many days you carry out test on concrete?	(a) 7 (b) 14 (c) 28 (d) no test
31	For how much time concrete batching plant revolve for concrete production?	(a) 1 mint (b) 2mint (c) 3mint (d) 4mint

32	What % age of tensile strength (fc') of concrete you get at your project?	(a) 8% of fc' (b) 10% of fc' (c) 12% of fc' (d) No test
33	What type of steel bar is used at your site?	(a) Grade 40 hot rolled (b) Grade 60 Hot rolled (c) Grade 40 cold twisted (d) Grade 60 Cold twisted
34	Which quality of mixing water you used at your site	(a) Tap water (b) Distilled water (c) any quality (d) never checked quality
<b>Section-4: Remarks and Suggestions</b>		
35	Please notify us about what, in your point of view, is vital to improve quality control management in construction industry of Iraq?	
In my opinion, choosing the right quality equipment is the first and most important step in quality assurance. Then the project needs impartial supervision and compliance with the requirements.		
Negligence or corruption cannot be accepted by inspectors, contractors and customers as major projects and long-standing construction projects have been completed. However, I believe that if anti-corruption departments take over, full supervision of equipment quality and the development of a quality management system with honesty and integrity is possible.		
Action against corruption.		
Remark of your Project in the index of your observation?		

## **RESMUE**

### **EDUCATIONAL QUALIFICATIONS**

- BSC civil engineering
- Academic of Al-Mustansiriya university year of graduation 2017-2018
- MSc master of engineering management Istanbul Gedik University

### **PROFESSIONAL QUALIFICATIONS**

- I followed by civil engineering national and international specifications training.
- I followed by Civil engineering tests according to standard specifications training.
- I followed by evaluation of concert constructor.
- Good experience using Microsoft programs.
- Good experience using design programs ( AUTO CAD ,Etabs).
- Good to use the leveling device.
- Good in management field.