University of Bahrain

College of Engineering



Department of Mechanical Engineering

Assessment of TQM Implementation in the Construction of Mega Building Projects in Bahrain

A Thesis Submitted in Partial Fulfillment of the Requirements for the Master's degree in engineering management

Submitted by:

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Supervised by:

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January 2022

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University of Bahrain
Deanship of Graduate Studies
And scientific Research

جامعة البحرين
عمادة الدراسات العليا والبحث العلمي

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The Discussion Committee met on 14-Nov-21 In Microsoft Teams. Upon discussing the student whose details are stated above in public, the discussion committee recommends the following:

The student is awarded a grade A- in the thesis subject.

☐ Without making any changes to the thesis.

☒ After making the modifications attached with this decision.

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In accordance with Decision No. 736/2013 dated 14/3/2013
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Abstract

The study aimed to investigate the key TQM factors to assure the successful implementation of TQM in the construction industry, particularly the mega building's construction firms in the Kingdom of Bahrain. This study pursues a descriptive research approach through the distribution of two questionnaires; a managerial questionnaire directed to 21 managers in these firms, while an operational questionnaire was distributed to 49 from the operational level of these firms including (engineer / technician / site inspector/ quality officer). The results revealed that there is a Significant Positive relationship between success factors (leadership, policy and strategy, continuous improvement, measurement and feedback, subcontractors and suppliers' quality management, processes management, resources management, education and training, and work environment and culture) and TQM implementation in the surveyed mega building's construction firms in the Kingdom of Bahrain. In addition, the results found that policy and strategy, continuous improvement, leadership, resources management, work environment and culture were the most influential factors that exerted a significant impact on TQM implementation in the investigated firms. The study concluded that these firms lack possessing dynamic response towards the rapid changes and instability of the business environment. Furthermore, it was concluded that these firms are relying heavily on their staff who handle their assigned tasks and also carrying on necessary improvement as per their job descriptions since there is no improvement team in the organization chart of these firms. Moreover, some of the employees do not have the expected autonomy entitled by their managers in incorporating changes in the tasks they are accomplishing. Additionally, the financial resources provided to support

the improvement activities were insufficient, thus it was concluded that these budgets are set in these firms towards the accomplishment of the construction projects, while there is no finance set aside for handling any needed improvements within these projects.

The study recommended to review the firms' policies to enable the proactive deal with the available resources to alleviate threats, and incorporate their decision making to address uncertainties that is implied within their dynamic business environment. Moreover, it is recommended to review the policies and practices relevant to the improvement process, and encouraging employees to have a voice in the suggestion of new ideas that might reinforce the improvement process. Additionally, to empower employees by delegating them the authority to initiate changes into their job activities for further improvements at the operational level of each department. Finally, it is recommended to assign adequate financing in terms of budget allocation to support carrying on any needed improvement to finance these needed improvements. building a quality culture is a collective responsibility of both parties.

As a result of the study, a forecasting model was introduced to help the contractors to predict the level of TQM implementation to assess and improve the process to ensure the effective and successful TQM implementation.

Dedication

To the Saul of my mother
I miss you.

Acknowledgement

I am pleased to extend my thanks to everyone who advised me, guided me, or contributed with me at any stage of preparing this research.

Special thanks are to be expressed to the educational and administrative members at the University of Bahrain, who contributed to our educational journey despite all the circumstances that we faced throughout the period of joining this scientific edifice.

I especially thank my distinguished supervisor, Dr. Bader AlMannai, for his patience, support and guidance, and for all of the opportunities I was given to further my research. His insightful feedback pushed me to sharpen my thinking and brought my work to a higher level.

My highest thanks to the greatest and best sister I have ever had, for the endless support, help, concerns and love. "Sister, you mean the world to me; you are a gift from Allah".

Deepest thanks to the most incredible friends, Muna, Noora, Sahar and Hedaya, for their nonstop support and unconditional love. "Thank you for pushing me forward to keep going when I was lost and depressed".

Last but not least, I would like to dedicate this to the purest souls that ascended to heaven, to my mother, who helped me through this long journey, who supported me, stood by my side and believed on me. "Mom, I love you and I miss you", and to the soul of my dear Father "I wish you were here".

List of Contents

Subject	Page
Accreditation by Jury	I
Abstract	II
Dedication	IV
Acknowledgement	V
List of Content	VI
List of Tables	XIV
List if Figures	XVII
List of abbreviations	XIX
List of Notations	XXI
List of Appendices	XXII
Chapter One **Introduction**	
1.1 Background	2
1.2 Problem Statement	3
1.3 Objectives of the study	6
1.4 Research questions	6
1.5 Significance of the research	7
1.5.1Theoretical Contribution	7
1.5.2 Practical Contribution	7
1.6 Methodology	8
Chapter Two **Literature Review**	

2.1 Introduction	10
2.2 Introduction to the success factors of TQM	10
2.2.1 TQM success factors definition	12
2.2.2 TQM success factors importance	13
2.2.3 TQM theoretical concept	16
2.2.4 TQM success factors dimensions	19
2.2.4.1 Leadership definition	19
2.2.4.1.1 Leadership importance	19
2.2.4.2 Continuous improvement definition	22
2.2.4.2.1 Continuous improvement importance	23
2.2.4.3 Measurement and feedback definition	25
2.2.4.3.1 Measurement and Feedback importance	25
2.2.4.4 Sub-contractors and supplier quality management definition	27
2.2.4.4.1 Subcontractors and supplier quality management importance	27
2.2.4.5 Process management definition	29
2.2.4.5.1 Process management importance	29
2.2.4.6 Policy and Strategy definition	31
2.2.4.6.1 Policy and Strategy importance	31
2.2.4.7 Resource Management definition	33
2.2.4.7.1 Resource Management importance	33
2.2.4.8 Education and Training definition	35
2.2.4.8.1 Education and Training importance	35
2.2.4.9 Work Environment and Culture definition *(Organizational Culture/ quality culture)*	36
2.2.4.9.1 Work Environment and Culture importance	37

(Organizational Culture/ quality culture)	
2.3 Introduction to Total Quality Management Implementation	39
2.3.1 Total Quality Management definition	41
2.3.2 Total Quality Management Implementation importance	41
2.3.3 Relationship between success factors of TQM Implementation and TQM/firm's performance	44
2.4 Related Studies	46
2.4.1 Regional Studies	46
2.4.2 Foreign Studies	53
2.5 Literature Summary	64
2.6 Chapter Summary	71
Chapter Three **Research Methodology, Data collection and Questionnaire Design**	
3.1 Introduction	73
3.2 Research Methodology	73
3.2.1 Research Approach	73
3.2.2 Purpose of the Research	74
3.2.3 Research Type	75
3.2.4 Research Tools	76
3.2.5 Research Plan	80
3.3 Data Collection	82
3.3.1 Approach to Data Collection	82
3.3.2 Research Tools	85
3.3.2.1 Literature review	85
3.3.2.2 Interviews with experts	86
3.3.2.3 Questionnaires	89
3.4 Questionnaire Design and Development	89

3.4.1 Unit of Analysis	89
3.4.2 Questionnaire design	90
3.4.3 Questionnaire type 1	91
3.4.4 Questionnaire type 2	93
3.4.5 Data Measurement	95
3.4.5.1 Likert scale	95
3.4.5.2 The relative importance index (RII) of TQM Implementation	97
3.5 Questionnaire Distribution	98
3.5.1 Population	98
3.5.2 Sample Size Determination	99
3.6 Chapter summary	100
Chapter 4 **Results and Analysis of Collected Data**	
4.1 Introduction	102
4.2 Distribution of the sample	102
4.2.1 Distribution of the sample according to Educational Level	103
4.2.2 Distribution of the sample according to Years of Experience in the construction industry	103
4.2.3 Distribution of the sample according to Number of enrolled training courses related to quality in the surveyed construction firms	104
4.2.4 Distribution of the sample according to Job Level	105
4.3 Validity and Reliability of the Questionnaires	106
4.3.1 Validity	106
4.3.2 Reliability of the scale	116
4.4 Results of the collected data	116
4.4.1 Managerial insights on adopted practices	117

4.4.1.1 The highest priority policy of the construction projects at the firm	117
4.4.1.2 The quality system and/or approach that firms adopt	118
4.4.1.3 Number of times the organization measures customer satisfaction	119
4.4.1.4 Organization's purpose of quality	120
4.4.1.5 Rating suppliers and subcontractors	121
4.4.1.6 Organization's approach in solving quality related problems	122
4.4.2 Understanding and practice of quality	123
4.4.2.1 The best definition of quality from employees' perceptions	123
4.4.2.2 The relationship between ISO standards and TQM	124
4.4.2.3 The highest priority policy of the construction projects at the firm	125
4.4.2.4 The quality improvement tools or techniques using by the firm	126
4.4.3 TQM Success Factor *(Managerial Level)*	128
4.4.3.1 *"Leadership"* factor in the Construction of Mega Building Projects	129
4.4.3.2 *"Policy and Strategy"* factor in the Construction of Mega Building Projects	131
4.4.3.3 *"Continuous Improvement"* factor in the Construction of Mega Building Projects	132
4.4.3.4 *"Measurement and Feedback"* factor in the Construction of Mega Building Projects	134
4.4.3.5 *"Subcontractors and Suppliers Quality Management"* factor in the Construction of Mega Building Projects	136
4.4.3.6 *"Processes management"* factor in the Construction of Mega Building Projects	138
4.4.4 TQM Success Factor *(Operational Level)*	139
4.4.4.1 *"Leadership"* factor in the Construction of Mega Building Projects	139

4.4.4.2 "Continuous Improvement" factor in the Construction of Mega Building Projects	141
4.4.4.3 *"Measurement and Feedback"* factor in the Construction of Mega Building Projects	143
4.4.4.4 *"Subcontractors and Suppliers Quality Management"* factor in the Construction of Mega Building Projects	145
4.4.4.5 *"Processes management"* factor in the Construction of Mega Building Projects	146
4.4.4.6 *"Resources Management"* in the Construction of Mega Building Projects	148
4.4.4.7 *"Education and Training"* in the Construction of Mega Building Projects	149
4.4.4.8 *"Work Environment and Culture"* in the Construction of Mega Building Projects	151
4.4.5 Critical Success Factors (CSF) of TQM implementation in the Construction of Mega Building Projects	152
4.4.6 TQM implementation (Organizational Performance)	155
4.4.6.1 TQM implementation (Organizational Performance) in the Construction of Mega Building Projects	155
4.4.6.2 Barriers of TQM implementation in the Construction of Mega Building	157
4.5 Correlation Analysis	159
4.5.1 Correlation analysis for the managerial survey	160
4.5.2 Correlation analysis for the operational survey	161
4.6 Regression Analysis	163
4.6.1 Regression analysis for the managerial survey	163
4.6.2 Regression analysis for the operational survey	164
4.7 Differences according to firms that adopt Quality System and firms that adopt TQM	166
4.8 Research Findings	167
4.9 Discussion of results	170
4.10 Recommendations	171

4.11 Chapter summary	174
Chapter 5 **Data collection, Design and Results of Questionnaire 2**	
5.1 Introduction	177
5.2 Data Collection	177
5.2.1Approach to Data Collection	177
5.2.2 Selection of Data Collected	178
5.2.2.1 Questionnaires	181
5.3 Questionnaire Design and Development	182
5.3.1 Target Audience	182
5.3.2 Questionnaire design	182
5.3.3 Data Measurement	182
5.3.4 Questionnaire Distribution	182
5.3.5 Population	182
5.3.6 Sample Size Determination	183
5.4 Questionnaire Results	183
5.4.1 Leadership	183
5.4.2 Continuous Improvement	188
5.5 Chapter summary	193
Chapter 6 **Modeling with Regression**	
6.1 Introduction	195
6.2 Regression Analysis	195
6.2.1 Mean Absolute Error	196
6.2.2 Mean Absolute Percentage Error	196
6.2.3 Root Mean Square Error	197

6.2.4 Coefficient of determination	197
6.3 Gaussian Regression	197
6.4 Model Building	201
6.4.1 Data Standardization and Organization	202
6.4.2 Software used to design Regression Model	202
6.4.3 Network structure and Data Entry	203
6.5 Model Training and Validation	204
6.5.1 Leadership Forecasting model	205
6.5.2 Continues Improvement forecasting model	214
6.6 Summary of Results	222
6.7 Chapter summary	224
Chapter 7 **Conclusion and Recommendations**	
7.1 Introduction	226
7.2 Conclusion	226
7.3 Limitation of the Study	232
7.4 Further Work Recommendations	232
References	
Appendices	

List of Tables

No.	Title	Page
2.1	Success Factors of TQM in previous studies	69
3.1	Types of Questionnaires for different studies	78
3.2	Potential Barriers of TQM Implementation used in the developed questionnaire based on previous studies	86
3.3	Additional success factors of TQM Implementation used in the developed questionnaire revealed from interviews with experts	87
3.4	Additional Barriers of TQM Implementation revealed from interviews with experts	88
3.5	Scale Items used in the questionnaire construct	90
3.6	Interpretation of Likert's five-point scale of Agreement	95
3.7	Interpretation of Likert's five-point scale of importance	96
3.8	Size of enterprise based on size of the project	99
4.1	Validity of the Leadership dimension	107
4.2	Validity of the Policy and strategy dimension	108
4.3	Validity of the Continuous improvement dimension	108
4.4	Validity of the Measurement and feedback dimension	109
4.5	Validity of the Subcontractors and suppliers' quality management dimension	110
4.6	Validity of the Processes management dimension	110
4.7	Validity of the Resources Management dimension	111
4.8	Validity of the Education and training dimension	112
4.9	Validity of the Work environment and culture dimension	112
4.10	Validity of the Critical Success Factors of TQM implementation dimension	113
4.11	Validity of TQM implementation (Organizational Performance) dimension	114

4.12	Validity of the Barriers of TQM implementation dimension	115
4.13	The quality improvement tools or techniques using by the firm	127
4.14	Leadership factor in the Construction of Mega Building Projects	129
4.15	Policy and Strategy factor in the Construction of Mega Building Projects	131
4.16	Continuous Improvement factor in the Construction of Mega Building Projects	133
4.17	Measurement and Feedback factor in the Construction of Mega Building Projects	134
4.18	Subcontractors and Suppliers Quality Management in the Construction of Mega Building Projects	136
4.19	Process Management in the Construction of Mega Building Projects	138
4.20	Leadership factor in the Construction of Mega Building Projects	140
4.21	Continuous Improvement factor in the Construction of Mega Building Projects	142
4.22	Measurement and Feedback factor in the Construction of Mega Building Projects	143
4.23	Subcontractors and Suppliers Quality Management in the Construction of Mega Building Projects	145
4.24	Process Management in the Construction of Mega Building Projects	147
4.25	Resources Management in the Construction of Mega Building Projects	148
4.26	Education and Training in the Construction of Mega Building Projects	150
4.27	Work Environment and Culture in the Construction of Mega Building Projects	151
4.28	Critical Success Factors	153
4.29	TQM Implementation	155
4.30	Barriers of TQM implementation	157
4.31	Pearson Correlation Coefficient between Success factors	160

	and TQM implementation	
4.32	Correlation analysis between Success factors and TQM implementation	162
4.33	Multiple Regression analysis between Success factors and TQM implementation from the managers' perspective	163
4.34	Output of Coefficients for the Multiple Regressions of the managerial survey	164
4.35	Multiple Regression analysis between Success factors and TQM implementation from the employees' perspective	165
4.36	Output of Coefficients for the Multiple Regressions of the operational survey	165
4.37	Significance of the Differences between firms that adopt Quality System and firms that adopt TQM	166
5.1	Means of TQM elements implementation from Managerial and Operational level perspectives	179
5.2	Weight of Critical Success Factors with Leadership in order to get a 100% achievement level	184
5.3	Weight of Critical Success Factors with Leadership in order to get a 70% achievement level	185
5.4	Weight of Critical Success Factors with Leadership in order to get a 50% achievement level	186
5.5	Weight of Critical Success Factors with Leadership in order to get a 20% achievement level	187
5.6	Weight of Critical Success Factors with Continuous Improvement in order to get a 100% achievement level	189
5.7	Weight of Critical Success Factors with Continuous Improvement in order to get a 70% achievement level	190
5.8	Weight of Critical Success Factors with Continuous Improvement in order to get a 50% achievement level	191
5.9	Weight of Critical Success Factors with Continuous Improvement in order to get a 20% achievement level	192
6.1	Performance of Test Sample Model for Leadership	209
6.2	Performance of Test Sample Model for Continues improvement	217

List of Figures

No	Title	Page
3.1	Common types of interviews (Hobson and Townsend, 2010)	77
3.2	Research plan	81
3.3	Approach to Data Collection	83
3.4	Data collection process	84
4.1	Distribution of the sample according to qualification	103
4.2	Distribution of the sample according to years of experience	104
4.3	Distribution of the Sample According to Number of training courses related to quality in construction	105
4.4	Distribution of the Sample According to Job level	106
4.5	Percentage of the highest priority policy of the construction projects at the firm	118
4.6	Quality system and/or approach that firms adopt	119
4.7	Number of times customer satisfaction is measured	120
4.8	Organization’s purpose of quality	121
4.9	Rating suppliers and subcontractors	122
4.10	Organization’s approach in solving quality related problems	123
4.11	The best definition of quality from employees’ perceptions	124
4.12	The relationship between ISO standards and TQM	125
4.13	The highest priority policy of the construction projects at the firm	126
4.14	The quality improvement tools or techniques adopted in the surveyed firms	128
5.1	Chart of Means for Implementation level according to Managerial level	180
5.2	Means of Implementation level according to Operational level	181
6.1	Flowchart of the training regression model workflow	204
6.2	Data entry for the trained model with 10 cross-validation folds	206

6.3	Response plot of the data	207
6.4	Visualize summary statistics	207
6.5	The History list show the models overall score.	208
6.6	Model Statistics	209
6.7	Response plot: Plot the actual versus predicted responses	211
6.8	Plot Predicted vs. Actual Response	212
6.9	Residuals Plot	213
6.10	Box Chart plot	214
6.11	Data entry for the trained model with 29% Holdout validation	215
6.12	Response plot of the data	216
6.13	The History list show the models overall score	217
6.14	Model Statistics	218
6.15	Response plot: Plot the actual versus predicted responses	219
6.16	Plot Predicted vs. Actual Response	220
6.17	Residuals Plot	221
6.18	Box Chart plot	222

List of Abbreviations

APE	Absolute Percentage Error
CSF	Critical Success Factors
GDP	Gross Domestic Product
GP	Gaussian Processes
GPR	Gaussian Process Regression
HR	Human Resources
HRM	Human Resource Management
IPA	Importance Performance Analysis
MAE	Mean Absolute Error
MAPE	Mean Absolute Percentage Error
MCDM	Multiple-Criteria Decision-Making
MLR	Multiple Linear Regression
MOW	Ministry of Works, Municipalities Affairs and Urban Planning
MSE	Mean Square Error
PDCA	Plan, Do, Check, and Act
QC	Quality Culture
QFD	Quality Function Deployment
QM	Quality Management
R	Coefficient of Determination
RA	Regression Analysis
RII	Relative Importance Index
RMSE	Root Mean Square Error
SCM	Supply Chain Management
SD	Standard Deviation
SME	Small Medium Enterprises

SQM	Strategic Quality Management
SPSS	Statistical Package for Social Sciences
TQM	Total Quality Management
UAE	United Arab Emirates
UTM	Universiti Technology Malaysia

List of Notations

n	Sample Size for Finite Population
n°	Sample Size from Infinite Population
N	Population Size
z^2	Abscissa of the Normal Curve
p	Estimated Proportion of an Attribute
q	1- p
1 - α	Desired Confidence Level
n_1	Number of Respondents Who Scored 1
n_2	Number of Respondents Who Scored 2
n_3	Number of Respondents Who Scored 3
n_4	Number of Respondents Who Scored 4
n_5	Number of Respondents Who Scored 5
A_t	Actual value
F_t	Forecast value

List of Appendices

No	Appendix
A	Questionnaire1 - type 1 for Managerial level
B	Questionnaire1 - type 2 for Operational level
C	List of building contractors registered with ministry of works year 2019/2020 - Grade (AA) and Grade (A) building contractors
D	Check sheet of the adopted quality improvement tools or techniques using by the surveyed firms
E	Questionnaire 2
F	Model formulating process by MATLAB

CHAPTER 1
Introduction

1.1 Background

1.2 Problem Statement

1.3 Objectives of the Study

1.4 Research Questions

1.5 Significance of the Research

1.6 Methodology

Chapter 1
Introduction

1.1 Background

In today's competitive environment, quality has surged as a critical tool for assessing firms' performance (Sadq et al., 2020). Numerous quality methods and techniques were deployed to achieve this management goal (Alharth et al., 2017), and total quality management (TQM) was established amongst the most effective quality techniques used. Since its launch in the early 1980s, TQM has contributed tremendously to management practices around the globe. Despite that, firms did not realize its prominence as a source of competitive advantage (Othman et al., 2020).

Total Quality Management constitutes a strategic management approach, that implies improving firms' products and processes and achieve customer satisfaction (Benzaquen and Charles, 2020). This triggers organization to acknowledge TQM, as a driver for innovation, an integral component to the organization culture, and a significant contributor to the survival of organizations (Nasim et al., 2019).

Drawing on this premise, TQM implies organization' persistence to create a climate conducive to continuous enhancement in providing high-quality products and services to customers (Ooi et al., 2011). It is noteworthy, that firms pursue TQM to raise productivity, upsurge profitability, and expand market share to achieve organizational excellence (Kaur et al., 2019).

Initially, TQM was first embraced in manufacturing industries and the extant of literature on TQM implementation practices has predominantly emphasized on manufacturing firms (Mahmood et al., 2014; Singh and Ahuja, 2014). Despite that,

recently, the concept of TQM has also been implemented in the service sector (Arasli, 2012; Talib et al., 2013; Psomas and Jaca, 2016), while considering the distinct characteristics of services; intangibility, heterogeneity, inseparability and perishability (Jyoti et al., 2017).

In 1990s, TQM has emerged in the construction industry across many countries as "an improvement strategy". This management instrument continuously enhances quality performance in several aspects of the firms, through its powerful methodology, commonly known as (PDCA); Plan, Do, Check, and Act) cycle. However, there are various obstacles to apply TQM effectively in the construction firms (Tang et al., 2009). TQM in construction firm is a distinctive tool that urges receiving paramount seriousness in any construction project, particularly as it covers all required activities of integrating all structures and procedures to achieve excellence in the project (Erande and Pimplikar, 2016). Such improvement is digested by the client in construction industry in terms of excitement from the projects' design, accurate time line, affordable budget and free defects with, efficient, safe and by trustworthy firms (Likita et al., 2017).

1.2 Problem Statement

Worldwide, the bulk of construction firms encounter numerous challenges, such as workmanship defects, delay, and cost overrun, in completing their projects (Neyestani, and Juanzon, 2016). Whereas, in Bahrain, it is noteworthy that the construction sector catered to 10.7% GDP growth in 2014, thus, occupying the second rank following the social and personnel service sector. In addition, it contributed by 7.3% in the growth of the Bahrain non-oil economy in 2014 compared to 2013. This growth was primarily attributed to the prioritization of the

construction projects in the kingdom that its main goal is to accomplish projects in definite time line, agreed budget and imperative quality. Despite that, the construction sector is in face of several acute challenges. Cost overrun is one of these key challenges as nine out of ten construction projects transcend their budget, with an 86% likelihood of outrunning their established cost targets, and with minimal chances of improving such cost as these overruns did not improved worldwide along the past 70 years as reported by Flyvbjerg et al., (2002, 2003). This is asserted with the substantial number of construction projects that failed to proceed, and the severe fear of investors that call for in-depth investigation to find out a solution to this issue (Abusafiya and Suliman, 2017). Other challenges are the complexity and the substantial size of the construction projects, particularly those for mega scale. As this entails numerous clients, distinctive professional requirements, critical time schedule, and perilous process dependencies. Based on this, there is high potential of inefficiencies that drove construction firms to shift towards an orientated quality approach, to guarantee high efficiency and low likelihood of failure (Mashali et al., 2020; Olawumi and Chan, 2018).

In the same vein, the fierce competition brought by globalization has urged construction firms worldwide to shift towards the effective implementation of a "total quality management (TQM) system" (Harrington et al., 2012; Neyestani, and Juanzon, 2016). Whilst, in Bahrain, the general consensus regarding mega construction projects is being characterized by delays and budget overrun. These problems arise, either due to the lack of quality management system or because of the ineffective implementation of such quality systems (Evans et al., 2020).

Although, TQM can generate many benefits for the firm (Hong et al., 2019; Panuwatwanich and Nguyen, 2017; and Wong, Lai et al., 2015), its

implementation still remains cumbersome and pose several challenges (Benzaquen and Charles, 2020). This along with lack of empirical findings published about TQM implementation in the building's construction projects in Bahrain. As the extant of literature is suffering from scarce studies in investigating TQM implementation in developing countries (Benzaquen and Charles, 2020).

This drove scholars and researchers to examine the elements that are considered as antecedents to TQM implementation, in other words the success factors that might assure quality development, implementation, and management. Thus, efforts were exerted by both scholars and practitioners to device the proper tools for quality improvement that are indispensable for successful TQM implementation (Benzaquen and Charles, 2020). However, the issue becomes more problematic, due to the disagreement regarding which success factors can contribute to TQM implementation (Bouranta, Psomas, Suárez-Barraza, and Jaca, 2019).

Additionally, the dearth of broad consensus on communal TQM factors have resulted from differences in methodological approaches carried on by researchers (Sila and Ebrahimpour, 2003), firm size (Brah et al., 2002; Sila, 2007), ratio of employment in this sector (Psychogios, 2010), or the contextual geographic environments where the investigated firms operate (Yoo et al., 2006; Psychogios et al., 2008). Therefore, the intriguing question in terms of the universality of TQM factors has not yet been adequately answered. Subsequently, more empirical studies and cross-boundaries research are needed (Bouranta et al., 2019).

Based on the above, this study is conducted to assess to address this gap in TQM literature; by investigating the extent of TQM implementation in local building's construction projects. In addition, to solve the related problems and determining the effective forecasting model for achieving high level of efficiency.

1.3 Objectives of the study

The broad aim of this study is to investigate the key TQM factors to assure the successful implementation of TQM in the construction industry in the Kingdom of Bahrain, Whilst, the specific objectives are as follow:

1. To assess the extent of TQM implementation effectiveness in mega building's construction projects in Bahrain.
2. To identify the critical success factors for TQM implementation in mega building's construction projects in Bahrain.
3. To develop a forecasting model to predict the effective implementation of TQM in the construction of mega building's construction projects in Bahrain.

1.4 Research questions

1. What is the extent of TQM implementation effectiveness in mega building's construction projects in the Kingdom of Bahrain?
2. What are the critical success factors for TQM implementation in mega building's construction projects in Bahrain?
3. What are the main elements that drive the effective implementation of TQM in the construction of mega building's construction projects in Bahrain?

1.5 Significance of the research

This current research is expected to have a sound theoretical contribution, as well as follow:

1.5.1 Theoretical Contribution

- This study is expected to assess to address the gaps in the body of TQM literature, in terms of lack of a consensus on what success factors can predict efficient implementation of TQM (Benzaquen and Charles, 2020).

- Furthermore, this study will contribute to the theory, by responding to a very recent call in the TQM literature "more empirical studies and cross-boundaries research are needed" (Bouranta et al., 2019). In addition to the large number of construction projects failing to proceed, and the serious concern of investors, which needs an in-depth research to put forward with solution to this issue" (Abusafiya and Suliman, 2017).

1.5.2 Practical Contribution

This research constitutes a serious attempt to generate an effective solution towards overcoming the challenges that block the implementation of TQM in the mega building's construction projects in Kingdom of Bahrain. Thus, by proposing a TQM forecasting implementation model will enable construction firms predict implementation that subsequently assess to solve the constructions issues pertinent to delays and budget overrun, to promote the efficiency of the construction firms' process and operations, which would strengthen these firms' competitive capacity in the market. By doing so, the construction sector in Bahrain will flourish, thus

boosting the economic growth of Bahrain and enable the kingdom to be on the competition edge among other Gulf Cooperation Council countries.

1.6 Methodology

In order to develop a forecasting model for the prediction of the effective TQM implementation, identification of the critical success factors of TQM is essential, as well as, an assessment of the effectiveness of TQM implementation in the mega building's construction projects in Bahrain. To accomplish this, quantitative and qualitative techniques are applied to collect and analyse required data.

- Data collection:

Data was collected through cross- sectional questionnaires, as well as, interviews that were held with experts in the construction sector in Bahrain, to reveal their opinions regarding the effectiveness of TQM implementation in the mega building's construction projects in Bahrain.

- Data analysis:

Data collected were analysed using Statistical Package for Social Sciences (SPSS v 24) to carry on the Descriptive statistical analysis, inferential statistical analysis, and Regression modelling.

CHAPTER 2
Literature Review

2.1 Introduction

2.2 Introduction to the success factors of TQM

2.3 Introduction to Total Quality Management Implementation

2.4 Related Studies

2.5 Literature Summary

2.6 Chapter Summary

Chapter 2

Literature Review

2.1 Introduction

This chapter presents the success factors for TQM implementation, definition and importance of TQM, conceptual/ theory building TQM, dimensions of success factors of TQM implementation and an introduction to TQM management.

2.2 Introduction to TQM Success Factors

The technique of Critical Success Factors (CSFs) is relying on the identification of the effective core activities affecting the success of the implementation and need to be focused and consider the rest as secondary activities that are auxiliary factors to support in the planning of activities and resources, as well as to plan the key areas by facilitating the function of priorities within it (Talib and Rahman, 2010).

Further, companies needs to identify and evaluate the critical success factors before starting the implementation process, since the those factors are responsible of the implementation success thus the business success (Hietschold, Reinhardt, and Gurtner, 2014; Anil and Satish, 2016; Hussain and Khan, 2020).

Accordingly, it is required to understand the concept of TQM and its success factors to determine the level of commitment and resources required for its successful implementation (Shahbazipour, 2007). Total quality management is a sophisticated approach that affects the company's management style, policy, culture, and size. Due to the absence of a standard or certain procedure to follow while implementing TQM, researchers extracted the concept and key factors by

leading gurus who demonstrated various approaches in the quality improvement process, such as Deming, Crosby, Feigenbaum, Saraph, etc. (Hussain and Khan, 2020).

In order to benefit from TQM effectively, organisations require certain preconditions. These CSFs are best practices, enablers or keys, which drive a company's success (Hietschold et al., 2014). CSFs are conceptualised as initial inputs, which affect the adoption of quality management practices in a critical way (Hietschold et al., 2014). A multitude of different CSFs exist. These CSFs influence the success or failure of TQM implementation (Salaheldin 2009).

Today, scientific research dealing with TQM's CSFs is readily available studies. Factors and principles were presented by Brocka and Brocka (1992), and Evans and Lindsay (2001); categories were presented by Wilkinson (1992) and Oakland (2000); and hard and soft factors were presented by Georgiev and Ohtaki, (2020). Generally speaking, CSFs may be viewed as variables that determine firm performance through successful implementation of TQM. According to Karuppusami and Gandhinathan (2006), TQM CSFs are fundamental to the success of organizations, so they must be carefully managed and controlled to further improve performance. CSFs are circumstances or practices and requirements or things that must go well. CSFs are crucial not only to the success of the TQM process or program, but also to firm performance (Aquilanim et al., 2017).

In recent times, it becomes very difficult to maintain success in the market due to the enormous growth of globalization, development of technology, high competition and following modern management approaches that affects the technology and economy (Al-Khalifa and Aspinwall, 2001). TQM thought-about

being one among the foremost long management innovations within the recent decades. TQM relies mainly on employee's knowledge and experience in all organizational levels together with the management that has to continuously improve all activities to achieve the organizational goals (Aletaiby, Kulatunga and Pathirage, 2017).

For any company to insure the success of TQM implementation, it is essential to identify the distinguished elements that affects the implementation process. These elements are the key success factors of TQM that should be identified to guide companies to understand TQM and enable the application of this approach. Due to the fact, that there is no agreement regarding the exact identification of critical factors of quality, the common factors were selected by most of the authors. For example, leadership has always been included so it is considered to be 'nearly-universal', whilst the rest are secondary. Communication, teamwork, training and education are some examples of 'nearly-universal' success factors. Labour-union relations are an example of secondary factors. Researchers such as (Flynn et al., 1994; Yasamis et al., 2002; Koh and Low 2010; Kumar et al., 2011; Hietschold et al., 2014 and Neyestani and Juanzon, 2016) have contributed to the examination of the key factors of TQM implementation, where they came up with more or fewer factors, but of the same ground.

2.2.1 TQM success factors definition

According to Sila and Ebrahimpour (2005) and Al-Ababneh and Lockwood (2012) Critical Success Factors (CSFs) of TQM can be described as "the best practices of TQM implementation". Whereas, Saraph, et al. (1989), defined critical factors as

“critical areas of managerial planning and actions that must be practised to achieve effective quality management in business unit” (Hussain and Khan, 2020).

In addition, the Critical Success Factors (CSFs) of total Quality Management had been defined, by In'airat and Al-Kassem (2014), as the significant fields of exercise that have to be carried out well in order for an organization to accomplish its target.

2.2.2 TQM success factors importance

The “critical success factors” (CSF) method is an approach used to define the things that must go well, in order to ensure organisational success (Boynton and Zmud, 1984, p. 17). So far, this approach has been applied within the quality management (QM) discipline, by a number of scholars in an attempt to account for the critical factors for successful total quality management (TQM) implementation (Saraph, Benson and Schroeder, 1989; Kanji and Yui, 1997; Conca, Llopis and Tarı, 2004; Hietschold et al., 2014; Aquilani et al., 2017 and Sreedharan and Sunder, 2018). Furthermore, even though there is a consensus on what the real factors are, the entire factors have not been reached yet (Samson and Terziovski, 1999; Conca et al., 2004 and Hietschold et al., 2014).

Most QM researchers and practitioners agree that the CSFs, in the case of TQM, can be grouped in two main categories – hard factors (e.g. production techniques such as statistical process control) and soft factors (e.g. top management involvement and leadership) (Wilkinson, 1992; Black and Porter, 1996; Rahman and Bullock, 2005; Bou-Llusar et al., 2009; Modgil and Sharma, 2017; Saleh, Sweis and Mahmoud Saleh, 2018). On the other hand, the soft factors have been argued to be more critical to TQM implementation (Pegels, 1994; Samson and

Terziovski, 1999; Rahman, 2004; Calvo-Mora et al., 2013; Georgiev and Ohtaki, 2020).

Pushpa (2016), stated that according to several studies in Arab countries, there are seven (CSFs) to a successful TQM implementation; such as: vision and plan statement, employee involvement, customer focus, reward and recognition, education and training, commitment of top management, and quality management supplier. While, Sharma et al. (2014), maintained that there are six required critical factors for a suitable implementation of TQM: Management commitment, culture, continuous improvement, cooperation and customer focus, and control.

To sum up, the literature related to CSFs of TQM, suggests that top management and leadership support, training, process management, employees involvement and empowerment, continuous improvement, and organizational culture; are the overall most common, important and critical success factor in the implementation of TQM (Salama and Swareldahab, 2019).

Since then, the hard and soft TQM approach has found wide application in the literature pertaining to TQM's critical components (Dean and Bowen, 1994; Oakland, 2000; Rahman and Bullock, 2005; Calvo-Mora et al., 2013 and Aquilani et al., 2017). It is important, however, to stipulate that just as the general perspective on TQM's critical of the components, the hard and soft factor perspective also suffers from a disagreement among QM researchers, as to how these factors should be divided (Saleh and Sweis, 2017). For instance, Al-Nofal et al., (2004) argue that the critical component "top management leadership" can be regarded as both hard and soft. Given this, studies that have sought to develop a synthesised list of TQM's CSFs from the hard and soft factor perspective vary

significantly in terms of the number of identified constructs (Georgiev and Ohtaki, 2020).

TQM as a holistic management concept for continuous improvement of the quality of goods and services delivered through the participation of all levels and functions of the organisation (Singh and Dubey, 2013). According to Leong et al., (2014), implementing quality management systems such as TQM improves communication problems, minimises mistakes, reduces rework and wastage of materials, and exercises better control on sub-contractors and suppliers. Simple and understandable principles and philosophical foundations and providing a natural context for efforts are perhaps the limited options of managers to continuously improve their organisation. Using the analysis of the identity of the organisation, the senior managers of the organisation determine key processes prepare, and mobilise all members of the organisation i.e., the owners of the processes to fulfil the organisation's mission and to meet the needs and expectations of customers. Meanwhile, employees join senior managers in improving the performance of key processes. The result of the two top-down and bottom-up movements will lead to fundamental and directional transformations in the organisation. Apart from any influence derived from implementation, some authors advocated that certification could be a good first step toward a TQM system, raising awareness of quality among workers and a good climate for implementing it (Taylor, 1995; Tummala et al., 1996; Skrabec, 1999 and Escanciano et al., 2001). Regarding this point, implementation of the standard was advised with the aim of implementing TQM, in order to obtain maximum benefits from the registration (Brecka, 1994; Meegan and Taylor 1997; Huarng, Horng and Chen, 1999; Hughes, Williams and Ryall, 2000; Sun, 2000; Gotzamani and

Tsiotras, 2001). Quality management tools and techniques are practical methods, skills, and means or mechanisms that can be applied to particular tasks (Fotopoulos and Psomas, 2009). On the other hand, achieving a superior system in quality management can be considered as an imperative subject for any organisation (Goharshenasan and Shahin, 2017).

2.2.3 TQM theoretical concept

The concept of quality management (QM) is quite old and originated in Japan after the Second World War in late 1940s; then, the emphasis was on improving quality and using quality control tools in the manufacturing sector (Demirbag, Tatoglu, Tekinkus and Zaim, 2006; Talib, Rahman and Qureshi, 2011). Later, the QM concept moved to USA, UK, and other countries and it was applied in different manufacturing and service sectors. Mohammad (2006) defined TQM as an effective system for integrating the quality development, quality maintenance, and quality improvement efforts of various aspects of a system, so as to enable services at most economical level and derive full satisfaction. It is concerned with the management of quality principle in all the facets of a business including customers and suppliers (Dale, Boaden and Lascelles, 1994; Lockwood, Baker and Ghillyer, 1996; Kumar and Sharma, 2017).

From the past few decades, TQM has been extensively discussed in the literature and can be seen as a management philosophy characterised by its principles, practices, and strategies that emphasises upon continuous improvement in quality, increased involvement of employees, commitment of top management, employee empowerment, teamwork, benchmarking, leadership, rewards and recognitions, feedback, and relationship with suppliers (Dean and Bowen, 1994 and Rönnbäck

and Witell, 2008). Seth and Tripathi (2005) emphasis on these critical factors: leadership, process management and strategic planning; and approach-specific factors like equipment management, and focus on customer satisfaction when industries implement TQM and total productive maintenance (TPM) together. Bhat and Rajashekhar (2009) presented the following major barriers of TQM implementation in their paper. Lack of customer orientation, lack of planning for quality, lack of total involvement, lack of management commitment, and lack of resources. Furthermore, Dubey and Singh (2015) demonstrate that the relationship with internal and external partners, quality culture, human resource, and visionary leadership, are positive and statistically significant determinants of the cement manufacturing firm's performance. According to Dubey (2015), 'top management support' providing cutting edge; 'training' helps to build 'team work'; and 'team work' is vital to 'TQM' and 'lean behaviour' which helps to improve business performance. Tanwer, Prajapati and Singh (2015) and Talib and Rahman (2010) found the following factors to be critical to TQM implementation success: top management support, strategy, continuous improvement, benchmarking, environmental training, employee empowerment, customer focus, quality system, HR factor, recognition and reward, quality service technologies, service design, organisational culture organisational learning, and social responsibility. However, Khanna et al., (2011) found process management; top management leadership and customer focus are the top three factors for the implementation of TQM in the Indian manufacturing industry. While, Boateng-Okrah and Fening (2012) found senior management commitment; total quality training, customer driven information, and availability of quality data, TQM methods, and supplier involvement are the factors and values to managers who are interested in a

comprehensive approach to achieving organisational excellence. Moreover, human factors are also important role in TQM implementation. Grover, Agrawal and Khan (2006) suggested that various human factors in terms of the ‘human index’, which affect the TQM culture (Kumar and Sharma, 2017).

Total Quality Management (TQM), thus is viewed as a management philosophy that yield from incorporating Deming, Juran and Crosby quality management styles. For Deming who is viewed as the father of TQM, quality is identified by customers and in compliance to their demands. Therefore, management should assign all available resources and devote efforts to reveal the demands and preferences of those consumers. His philosophy of quality stemmed from a grounded theory, statistical thinking, application of statistical techniques to processes and the ongoing improvement cycle, as well as all needed tools to promote the quality of processes (Deming, 1986). While, Juran's philosophy describes quality as fitting the usage of a product or a service in accordance to customers’ needs. He suggested a strategic and structured approach to attain quality, with an emphasis on planning, controlling and improving the quality of operations (Deming, 1986). On the other hand, Crosby definition of quality is the outcome of defect prevention and alignment with the requirements. In his philosophy, measurement emphasize on the cost of quality in terms of money. His theory known as 'zero defects' is not attributed to an ideal product, however to the firm’ commitment to meet the requirements every time (Benzaquen and Charles, 2020).

2.2.4 TQM success factors dimensions

A significant challenge in studying TQM implementation from the CSF perspective, has been the lack of an agreement on what the real TQM factors are (Samson and Terziovski, (1999); Sila and Ebrahimpour, (2003); Calvo-Mora et al., (2013) and Georgiev and Ohtaki, (2020)). In another word, as there is no general consensus regarding the critical factors of quality, the majority have cited various factors that are common (Aletaiby et al., 2017). Drawing on that, this current study is investigating leadership, continuous improvement, customer feedback, sub-contractors (suppliers quality management), and process management.

2.2.4.1 Leadership definition

Leadership is the leader's capacity to affect the attitude and activities of others to attain organizational goals (Robbinsons, 2003). It is defined as a pattern of power where one can influence or change the conviction, values, and inclinations of another one (Ahmed, Y. 2020). In addition, leadership refers to the relationship between the individual, who lead and subordinates, who accept to pursue, and implying activities pertinent to directing and coordinating; whether individuals or teams; towards a common objective (Ganta and Manukonda, 2014).

2.2.4.1.1 Leadership importance

The support of the top management and its commitment to implementing TQM is the result of belief towards the inevitability of constant development and improvement, and it clarifies this by affirming the desire to apply TQM at all hierarchical levels and its workers. And taking plans that assure its adoption, as

well as the provision of both human and supplies indispensable for the process (Msallam, Al Shobaki and Abu-Naser, 2020).

The importance of leadership is also attributed to the leaders that must set vision, expectations, and values (Baldrige National Quality Program, 2014). Among the reasons for the success of implementing TQM, is the support provided by top management and integrating quality management as a culture in all carried tasks and processes implemented, the capacity to persuade, and impact employees. In another word, leadership is about promoting the quality's culture and improve the competences of employees in performing the assigned tasks (Hammoud, 2012). In addition to, assuring the efficacy of TQM, that necessitates the top management to adhere to its principles firmly (Riggs, 2014). Alimat (2004) highlighted the vitality of the leadership role in implementing total quality management, by nurturing subordinates' confidence and minimizing hierarchical levels and turning from the old-fashioned role of management from supervision to leadership and training. In addition, to ensuring that the quality is embedded in both type of activities; administrative and technical. In this context, the commitment of the top management to total quality management necessitates that the leadership would acquire the quality management philosophy to reap benefits, assign the proper resources, impose changes to implement TQM, and promote employees' performance; by compensating and training (Fadlallah 2015 and Saffar and Obeidat, 2020).

Leadership is the most prevailing factor in Total Quality Management and the implementation of corporate social responsibility according to Kaynach (2003) and Pedersen and Nyergaard (2008). The leaders of quality like Deming (1986), Feigenbaum (1991) and Ishikawa (1985) have highlighted crucially the role of top

management and its accountable responsibility for an organization. Therefore, leadership is perceived as critical factor in successfully implementing corporate social responsibility programs (Angus- Leppan et al., 2010 and Waldman and Siegel (2008).

Furthermore, commitment is perceived as the basis of efficacious TQM practice (Zhang et al., 2000) Thus, it can be said that the main driver for TQM practices' failure is the dearth of senior management ' commitment (Sitaraman et al., 2006).

Previous research have demonstrated that leadership committed to quality is important to TQM approach, and has a tremendous influence not only on stakeholders, but also on other shareholders; such as customers and employees. (Benavides-Velasco et al., 2014; Wang et al., 2012 and Tari, 2011). For example, if senior managers are dynamic in quality improvement, then their subordinates will be aspired to get engaged in quality management (Zhang et al., 2000). Therefore, leaders must communicate, encourage, and enable employees through an effective communication setting (Tan and Khoo, 2005; Khorshid, Amin and Ismail, 2018).

Prior studies in TQM practices highlight the massive contribution of leadership in leading the entire adoption of TQM in firms (Flynn et al., 1994). Deming (1986), triggers managers to establish leadership to as the engine that drive the transformation process towards quality. Chin et al. (2002) claim that leaders should practice the idealized influence of leadership by acting as a role model to their subordinates, setting clear goals, and create a conducive environment (Salleh et al., 2018).

With regard to its salient role in adopting the TQM, top management commitment is the starting point from which quality activities flow (Hietschold et al.,

2014). The commitment of top management represents the main driving force behind TQM, and thus, it is the responsibility to create an appropriate environment for the application of TQM. Accordingly, it is not possible to transform an organization into TQM unless the TQM practices in the firm are not implemented by the top management. Based on the premise that the primary task of top management is to ensure this transformation and ascertain its commitment to TQM activities (Aletaiby et al., 2017).

2.2.4.2 Continuous improvement definition

Msallam et al., (2020) define continuous improvement, as anything that is performed in the work context is subject to continuous assessment, as prevention is healthier than cure, and emphasis should be on completing the right things in the right way from the beginning.

Continuous improvement refers to the enduring desire of the firm to accomplish steady and substantial enhancement in all its operations, as continuous improvement emphasizes on creating effective channels of communication with all stakeholders, which is considered an indispensable element for improving quality in the long term (Hussain, 2005).

Continuous improvement involves the improvement of current products, processes, and systems in accordance to set standards of excellence; to identify potential areas of improvement (Kaur, Singh and Singh, 2019).

Continuous improvement can also be defined, as the process of gradual improvement in a firm that is done with the engagement of all employees (Sánchez-Ruiz, Blanco and Gómez-López, 2019).

2.2.4.2.1 Continuous improvement importance

Continuous improvement is one of the components of total quality management aimed to attain customer satisfaction, and it is considered a reliable source that assist employees to enhance and distinguish their firms from competitors, taking into consideration founding a quality department in these firms, and setting definite goals to enhance quality (Goetsch and Davis, 2010). According to van Aartsengel and Kurtoglu (2013) Continuous improvement is a tool to alter the direction of work to outperform in the short term, maintain profits, and rise long-term returns based on promoting customer satisfaction, enhancing employee abilities, and competencies.

Thus, continuous improvement entails that improvement to be a genuine and enduring desire in the firm and managed to achieve ongoing improvement in all operations and at all hierarchical levels by offering the staff with the needed skills, enrolling them in training courses, and motivating them to work in a team (Jacobson, McCoin, Lescallette, Russ and Slovis, 2009).

In this context, it is noteworthy to highlight that the introduction of the Deming cycle was one of the most prominent approaches to continuous improvement, as it impacts the job performance that consequently lead to a significant improvement in the firm' operations and aid in enhancing their performance and attaining highest extent of customers' satisfaction (Aishouni, 2009). Therefore, previous studies reported that both motivation and training boost employees' performance, productivity, minimize error ratios, and nurture employees' feelings of security (Saffar and Obeidat, 2020).

According to Zakuan et al., (2012) continuous improvement is capable to raise the job performance of employees as it enables them within less control. This is due to

the fact, that the assumption with continuous improvement is that everything is running fine and the acquired value can be raised either gradually or dramatically. Thus, continuous improvement necessitates the support of all partners, because it nourishes long relationship with clients, as well as organizational development (Salleh et al., 2018).

Based on that continuous improvement is the planned process that relies on changing current practices, thus, it highly contribute in improving the firm performance (Boer and Gertsen, 2003). This by its turn evidence that the firm has continuous endeavour to improve its operations and processes. Additionally, continuous improvement is able to raise the performance of those individuals who participates in the implementation of TQM (Aletaiby et al., 2017).

Continuous improvement drives the improvement of results to achieve better outcomes, from the strategic level to the detailed implementation of business elements in the work unit or department; accordingly, improvement is drawn in a plan to figure out how it will benefit the firm. Based on that, these results should be revised and evaluated to reveal whether the plan is workable and changes could be done. As a result, successful changes can be executed on a substantial scale, whilst envisioned ineffective changes are sent back to the planning board for adjustments. Rowley and Sherman (2004), explicated that employees who are perceived as successful advocates have typically focused on product or service continuous improvement to maximize their efficiency (Kumar and Sharma, 2017).

2.2.4.3 Measurement and feedback definition

Measurement and feedback is the most vital facet of production. This attend that the production and delivery of goods and services matches with the customer's present and future expectations (Dedy, 2016).

Measurement and feedback is a cycle that is formed from customer needs, fulfilling these needs, assessing success, and continually verifying these requirements to figure out the areas where improvements are needed.

2.2.4.3.1 Measurement and Feedback importance

The core of this notion is to fulfil customers' needs according to their expectations from the first time, and to direct employees to be more focused and attentive, regardless of the nature of their jobs. Thereby employees must examine customers' feedback on the offered services or products (Sugannthi and Samuel, 2015). Based on this premise, all activities and efforts should be focused on the customer to assure fulfilling his needs and exceeding his expectations. Accordingly, these needs and preferences must be identified (Boukmeish, 2010).

Customer feedback encompasses several dimensions, such as identification of customers, determining customer demands and preferences, and investigating customers ' trends, anticipations, follow up on negative comments or complaints and incorporate their views during the development of a product or service, leading to new customers attraction (Sugannthi and Samuel, 2015). Consequently, firms must identify their customers and investigate their needs and desires through specific ways that enable them through filling customer satisfaction surveys and enabling them to express their suggestions for further quality improvement (Juda, 2014; Saffar and Obeidat, 2020).

Based on that, the customer is considered one of the main pillars of TQM. There is a consensus in the literature among scholars that the emphasis should be on activities handled by employees, as they can contribute massively to TQM in terms of designing processes, products, and after sales service (Juma, 2007). It is obvious that the firm must operate to increase the efficiency of its employees through enrolling them in training, comprehending customers ' demands and to use special means to assess their satisfaction, find out the reasons for their withdrawal behavior and shifting to another competitor, and depend on their suggestions about the product or service they received. This will rise their satisfaction and enable the firm to attract new customers (Saffar and Obeidat, 2020).

The key factor of TQM, according to Richards (2012), is the measurement and feedback, and this depends on the quality being determined by the customer not by the firm or manufacturer of the product or service, because quality is what the consumer is expecting. Brah et al., (2002) argue that a firm success is conditioned on its customer satisfaction and to what extent their needs are fulfilled efficiently and effectively on an ongoing basis. In the same context, Zhang (2000), revealed that customer focus is the level the firm consistently meets customers' demands and expectations. Hence, it is one of the vital facets of Total Quality Management to enhance and promote business performance (Aletaiby et al., 2017).

Gladson Nwokah (2009), argued that customer orientation influences customer relationship, that by its turn affect the firm' performance. Miller and Roth (1994), revealed that innovators emphasis is on customization concept and a robust feedback mechanism. In such case, customers and quality are the priorities, whilst price is less important. Furthermore, their study found that innovators rate product

quality and exact time of delivery as the highest compared to other criteria. Firms implementing TQM achieved higher quality at a relatively lower price. This consequently will enable firms to protect their existing business, sustain their firm position in the market and prevent competitors' invasion by fulfilling customers' needs effectively (Kumar and Sharmar, 2017).

2.2.4.4 Sub-contractors and suppliers quality management definition

Supplier management is defined as the firm' capacity to optimize the stream of high quality and value for the cost of materials and supplies from a capable and creative supplier (Oly Ndubisi, Jantan, Cha Hing and Salleh Ayub, 2005).

Supplier partnership management revolves around the involvement of suppliers in decision-making, technology advance, and fulfilling customer anticipations through cooperation (Kaur et al., 2019).

2.2.4.4.1 Subcontractors and suppliers quality management importance

Scholars have agreed on three criteria for selecting a supplier drawing on quality "supplier assessment, supplier selection, and supplier development" (Schiele, 2007 and Reuter, Foerstl et al., 2010). Thus, efficient and effective supply management aid the firm to satisfy supplies quality standards for the production of products with high quality. Consequently, firms will be more opt to lessen variation in their processes, to reduce wastage and keep their inventory at acceptable rate (Truong and Nguyen, 2017). Based on the above, supplier management has emerged as a prominent factor for quality management as the key

challenge is poor quality materials that lead to excessive costs for the buyer and ruin the quality of the firm 's image (Khurshid et al., 2018).

Supplier engagement in the processes pertinent to the product design and quality enhancement expedites supplier response to quality issues, particularly quality inputs (Kaur et al., 2019). Fening et al., (2013) reported that quality management of a supplier is a fundamental part of quality management, as these supplies constitute a chief source of concern. Thus, the manufacturer must maintain a good relationship with the supplier to guarantee high quality supplies within the agreed time. Harrington, Voehl and Wiggin (2012) highlighted that TQM devote consideration to both labour and supplies. Regular visits and proper communications can aid in gaining supplier loyalty, and thus strengthening the relationship between the firm and the supplier. Marefat and Faridfathi (2015) revealed that firms desiring to generate high quality products should get high quality input from quality resources. Ardianto and Natsir (2014) found that materials management, proximity to customers, and company culture in supply chain management exert a significant role in enhancing the firm performance. Management must devote its efforts and time on categorizing many qualified and low cost suppliers for material supply through cooperation between several units and departments, such as purchasing, procurement, engineering and quality control". Firms should use proper tactics, and purchasing structures with planning and transportation systems with their suppliers (Islam and Al-Haq, 2012; Androwis et al., 2018).

Effective supplier is expedited by long-term coordinated relationships with the least number of suppliers to receive quality inputs and services. Keeping a few number of suppliers, promote productivity and product quality by stimulating

improved supplier commitment for both design and quality (Ansari et al., 1990). The supply chain assist in raising the overall quality commitment starting from supplier, to the manufacturer, to the end user - of a firm to attain excellence in manufacturing as well as service (Gupta, Prakash, Vishwakarma and Barua, 2017).

2.2.4.5 Process management definition

Process management is an essential part of the quality strategy (Porter and Parker, 1993). It is defined as a set of activities that are devised by a firm to manufacture products and services, which adds more value to both consumers and other shareholders (Khurshid et al., 2018).

Process management describes the deployment of statistical control process, increasing the automation of processes level of operations, and in the design process (Saraph et al., 1989; Sharma and Kodali, 2008).

2.2.4.5.1 Process management importance

For the sake of achieving a high quality in products or services, it necessitates an entire or fractional redesign of processes, to line up operations with requirements (Juda, 2014). It covers all firm processes in the organization that support the quality of the product /service, as well as in a way that prohibit errors (Boukmeish, 2010). This stands that going beyond focusing on outputs only, and emphasizing on processes, will lead to desirable outcomes (Aeeshe, 2012).

Operations improvement entails the firm ability to analyze the activities needed to deliver the service, minimizing activities, and business cycles that do not add any value to the product or service, simplifying procedures, reducing the number of

steps to provide service, moving from sequential operations to synchronized operations, reducing transfer time from department to another as a measure to lessen the time needed to provide the service (Barakat, 2007).

Operations management offers competencies and professionalism, and encompasses the procedures and practices, which promote business practices and rise the interdependence of job performance from the individual' perspective (Buck, 1999). Innovation in operations management is achieved through the contribution of employees in producing innovative solutions to problems, as well as developing and supporting innovation processes in the organization (Titi, 2010). According to Brun (2011), the application of total quality management practices. That implicitly comprises "process implementation", have an impact on the performance of employees and directly affect the performance of the organization (Saffar and Obeidat, 2020).

According to Prajogo and Sohal (2006), firms must seek be productive and engage proper ways to further boost the improvement process, to be more innovative and productive. In this context, it is noteworthy that Sadikoglu and Zehir (2010) reported that process management will reinforce product quality, by lessening variance, which might lead to enhanced reliability of the operations, innovation, and increased productivity (Prajogo and Sohal, 2006). Additionally, effective process management design will reduce negative environmental effect, thus, leading to lower costs and increased profits (Khurshid et al., 2018).

Process management as mentioned by Ibrahim et al. (2011), comprise a group of behavioural and talent practices that focus on the activities of these firms rather than achievement of results. Kanji (2012) found in Total Quality Management organization, the focus is not on formal structures. Instead, emphasis is placed on

forming operations management teams to solve the firms' problems. The key point, in this case, is to handle the employees responsibilities with the firm and sort out the processes accordingly. Thus, it can be said that the success of any organization depends on its focus on their processes, such as activities and tasks themselves more than issues (Aletaiby et al., 2017).

2.2.4.6 Policy and Strategy definition

In general, there is no broad consensus regarding strategic planning' definition. Coşkun (2011), described it as a constituent of strategic management. Bryson (2004) refers strategic planning to "a deliberative, disciplined approach to producing fundamental decisions and actions that shape and guide what an organization (or other entity) is, what it does, and why" (Salah, 2017).

Kantardjieva (2015) status that strategic planning is founded on the decision of making. It identifies the direction of the firm and its future standing, as well as the way to accomplishing that future.

2.2.4.6.1 Policy and Strategy importance

Coşkun (2011) claimed that strategic planning is the preliminary phase and base of strategic management. Similarly, strategic quality management is in the midst of the key components of TQM (Salah, 2017).

Strategic planning combines the expansion and use of plans, enhance relationships with clients, suppliers and other partners, and aids in attaining long and short-term goals through coordinated planning (Ooiet al., 2011; Hung et al., 2011). Actually, a significant association is established between strategic planning and quality performance (Prajogo and Cooper, 2017), role ambiguity avoidance and

knowledge management attitude (Ooi et al., 2011) and customer satisfaction (Sit et al., 2009).

Negi and Srivastava (2015) concluded that it is well known that TQM is a management approach, which employees can benefit from in numerous ways and that by articulating a strategic plan and pursuing it with a commitment towards continuous improvement, thereof, leaders can transform and develop their firms.

In addition, Mohsadeghard (2013) contends that a successful implementation of TQM necessitates a long-term strategic plan, because of the dearth of a comprehensive planning preceding the launch of TQM in a firm is a key driver for its future failure. Furthermore, it was stressed that strategic quality planning is indispensable for incorporating quality objectives and requirements into firms processes and activities (Asante and Ngulube, 2020).

Dahlgaard et al., (2015) reported that the strategic plan should relate the most valuable resource, namely manpower who implement the vision, mission, and strategy. This comprises all members across the firm, interpreting customer needs into short-term and long-term plans that lead the activities of every department (Movahedi and Koupaei 2011). According to Dror and Sukenik (2011), firms obviously enjoy a competitive advantage, while they can formulate an effective strategic plan, facilitating the transparency and interactivity of these firms provided by strategic planning, which nurtures commitment, coordination, and creativity. According to Zairi (2013), strategic planning across firms is imperative to generate a dynamic response towards the rapid changes and instability of the business environment, by dealing proactively with the available resources to alleviate threats, and by shifting decision makers' attention to address uncertainties (Oschman, 2017).

2.2.4.7 Resource Management definition

Resource management is the efficient and effective use of a firm' resources when they are required (Clegg and Bailey 2008; Benda et al., 2007).

Resource management is a main process in all firms. From a practical perspective, resource management is an assembly of relevant processes that are regularly oriented at the department level of these firms (Kandie et al., 2018).

Lastly, Burma (2014) described resource management a strategic and explicit approach for the firms' most precious assets at the disposable of employees (Obeidat et al., 2019).

2.2.4.7.1 Resource Management importance

According to Saleh and Hasan (2015), resource management can be assessed using sub variables like process of employee selection, employee satisfaction and complying of responsibilities for quality. Saleh and Hasan (2015) and Mohsadeghard (2013) argued that resource management problems, such as dearth of sufficient experience and knowledge, lack of staff empowerment and motivation, team orientation and improper time are resource management obstacles that impede the successful implementation of TQM in firms.

Resource management is another element of TQM in service firms that is linked intensely with customer satisfaction by triggering employees to work in a team to enhance organisation performance (Sit et al., 2009). It is also contended that resource management plays a salient role in reinforcing TQM implementation. Thus, practitioners and scholars have asserted that resource management has a significant influence on TQM implementation if there is congruence amongst its

practices (Salhieh and Abu-Doleh, 2015). Talib et al. (2013) found that resource management is crucial for promoting management processes and thus, firm' performance. In this vein, it is one of the critical success factor in TQM implementation and it is associated with quality performance positively. Khanna et al. (2011) postulated that in TQM implementation there is a strong assertion of employees' contribution and management involvement within the firm by enabling them to engage in continuous improvement (Asante and Ngulube, 2020).

Resource management practices are indispensable for any total quality management attainment. As incorporating these practices will ameliorate the quality of the system of the firm (Izvercian et al., 2014). Extant literature has evidenced that effective implementation of resources management practices triggers employees to excel in their job activities. Accordingly, the quality of management amplifies the physical prominence of the firm's competitive advantage, decrease production cost, and rise market share of the firm (Wang, 2014; Zare et al., 2015; and Ogbari and Borishade, 2015). The concept of TQM, though, determines that employees have a significant impact on the firm. In a dynamic viral environment, firms are pressurized to give and insightful focus to quality and resources management preconditions in order to support the business continuity (Usrof and Elmorsey, 2016).

In implementing total quality management processes in a firm, the human resource department plays a salient role in numerous areas, such as communicating the TQM vision, setting the needed details for TQM implementation, and offering the needed support to preserve the enthusiasm about TQM (Izvercian et al., 2014).Based on this premise, TQM impacts the firm's strategy at all levels. In terms of resource management, TQM has an effect on the firm's culture, as well as

its work organization, manning, performance appraisal, incentives, and training and development practices (Obeidat et al., 2019).

2.2.4.8 Education and Training definition

In the service industry, training and education refers to training and empowering employees to produce products and services. It is an indispensable part of TQM implementation, particularly in services, as it transfers the knowledge to employees about the principles of TQM, to attain the desirable goals (Talib and Rahman, 2010).

Additionally, training is described as a learning journey that entails the acquisition of knowledge and skills (Ahmed, 2018). In another definition, van Kemenade and Hardjono (2019) have defined training, as the organized endeavour to promote the knowledge and skills of an individual about his work.

2.2.4.8.1 Education and Training importance

Training and education are perceived as the most critical factor of resource management (RM); TQM training is considered a key to successful implementation of TQM that implies cost decrease and profit increase (Kassicieh and Yourstone, 1998). Training needs, motivation and enhancement of further performance evaluation are imperative to develop a quality-oriented HR performance assessment (Aquilani et al., 2017).

Training and education have emerged as a critical issue, due to the fast evolution of technological development. Training in quality knowledge is a prerequisite for involvement and empowerment (Kanji and Asher, 1993). TQM training is perceived as a key to successful implementation of TQM along the dimensions of

cost reduction and profit increase (Kassicieh and Yourstone, 1998). Therefore, employees furnished with knowledge and competencies can make productive contributions to quality (Trang and Do, 2020).

Based on the above, training is a critical factor that assist in making initiatives towards quality enhancement. According to Johanson and Vahlne (2003) an organization that sought quality will identify the proportion sample for the training not only for the current state, but for the future (Salleh et al., 2018).

Education and training impose employees to not only acquire the proper knowledge and skills to accomplish their jobs, but also to acquire particular knowledge, expertise and skills allied with TQM tasks. Among the numerous drivers that were reported in the literature and that were accountable for the failure of TQM endeavours encompass the dearth of proper training and insufficient knowledge. Employees will be triggered to participate in quality-oriented attitudes when the significance of their training caters to the whole quality goals (Goharshenasan and Shahin, 2017).

Insufficient education and inappropriate training constitute a chief impediment to the successful implementation of TQM. Training and education are major constituents in the TQM programme. In addition, it can generate more satisfied employees and conducive environment for creativity. Finally, it can expose employees to the pertinent knowledge and skills to perform their job effectively, and analyse and overcome the problems they encountered in their work context (Asante and Ngulube, 2020).

2.2.4.9 Work Environment and Culture definition *(Organizational Culture/ quality culture)*

Quality culture comprises firms' practices and core values that necessitates the readiness of employees and resources in a long lasting search for superior quality and service in a single dimension of the firm (Durana et al., 2019).

Further, it is the pattern of habits, tenets and attitude regarding quality (Popescu, Corboș and Bunea, 2018). In another meaning, it is an approach of life, where firms' practices reflect quality concepts, when quality is acknowledged by the individual as a personal value rather than routine edict (Malhi, 2013). Based on this premise, quality culture asserts the identical dynamics as any culture; it can be shaped as mutated (Taskinen, 2018).

2.2.4.9.1 Work Environment and Culture importance *(Organizational Culture/ quality culture)*

The importance of quality culture is derived from being one of the established critical success factors prior to the launch of TQM. According to Moghaddam and Moballeghi (2011), it is not easy to launch TQM. There is the need to generate an open and conducive culture by management. This is due to that the employees must feel that they are accountable for customer satisfaction. Scholars have claimed that employees might got a feeling of isolation, when they are precluded from the formulation of the vision and mission of the firm. By disregarding them, the employees may act in a reluctant way to hamper the process of TQM. Talib et al. (2013) also contended that quality culture is the corner stone of proceeding a change in an organisation. Successful TQM implementation necessitates a comprehensive understanding of critical success factors as well as the barriers that might block TQM implementation, thus quality culture was rated in the body of literature as a crucial factor (Moghaddam and Moballeghi, 2011). Sinha et al.

(2016) asserted that there is an association between culture and TQM involvements. It was also stressed that quality culture has a significant and robust impact on TQM implementation. Firms should disseminate a supportive OC before the adoption of any strategy (Al-Dhaafri and Al-Swidi, 2016). Thus, Baird, Hu and Reeve (2011) advocated that most firms require to be ready, by driving guidance as to the culture that is conducive to TQM, thereby contributing to the desired operational outcome (Asante and Ngulube, 2020).

Quality is not a process that can be deployed through assessment only, however it implies a set of values as well as practices embraced by the firm environment, and should be carried on by all the firm levels, as all the firm members contribute to the success of quality culture. These are perceived as the firm asset and its success relies on how those members are treated (Watson and Howarth, 2012). The activities and initiatives of employees are impacted by the prominent culture in a working context. Gherbal et al. (2012) affirmed, within the TQM culture an open and co-operative culture has to be leaded by the management in which all the employees regardless of their managerial levels or positions have to be made to feel that all of them are responsible for achieving the organisation's objectives (Aletaiby et al., 2017).

The culture is identified to encompass the knowledge, belief, morale, habit and any other activity gained by an individual (Maull et al., 2001). Thus, Quality culture's analysis is vital before the implementation of TQM practices. The TQM program is anticipated to be effective if the quality culture matches the values and basic concepts proposed by the TQM principles. It is obvious that failure in the endeavours to implement TQM can result from the non-conformance between quality culture and competitiveness (Alotaibi and Islam, 2013).

2.3 Introduction to Total Quality Management Implementation

The notion of quality is basically an economic word that has emerged from the industrial rivalry between advanced industrial firms, to monitor production and acquire customer confidence (Abu Sultan, 2011; Aeeshe, 2012). It is defined as the product's suitability for use, and thus its capacity to provide the optimum performance and the most precise qualities (Saeed et al., 2013 and Salami and Ufoma Akpobire, 2013). Moreover, Total Quality Management refers to Carrying out the work as planned correctly and from the first time, and relying on the judgement of the customer by getting his feedback on this work (Ali, 2010). Total quality management is a philosophy that target to continuously enhance products and services and improve the process by emphasizing on the customer needs and anticipations to increase customer satisfaction and organizational performance (Sadikoglu and Olcay, 2014; Saffar and Obeidat, 2020).

Drawing on the premise that there is no agreement among researchers regarding a definition for TQM, thus, it referred to the firm's extensive efforts to create a climate where there is a continuous improvement in its capacity to provide products and services with high Quality to customers (Nasim, Sikander and Tian, 2019).

Accordingly, it can be said that total quality management is a holistic term that stands for constant improvement of the quality of goods and services delivered through the engagement of all employees across all the administrative levels of the firm (Singh and Dube, 2013).

According to Leong et al. (2014), the implementation of quality management systems such as TQM solve communication problems, decrease errors, minimize

rework, and wastage of supplies, and enable effective control over subcontractors and suppliers. knowledge about work conceptions, productivity foundations, and providing a smooth conducive environment for performance are possibly the restricted options for managers to constantly improve their firms. Using the analysis of the firm's identity, senior managers refer total quality management to the principal processes, preparation, and assigning tasks to all firms' members, for instance the processes' owners to achieve the firm' mission and to fulfil the needs and anticipations of customers. Whilst, employees contribute to the efforts exerted by the top managers to enhancing the performance these processes. The outcome of both contributions from "top to bottom and bottom to top" yield vital and directional transformation in the firm (Goharshenasan and Shahin, 2017).

Apart from any impact resulting from such implementation, some scholars have claimed that certification is rather considered the initial step towards establishing a total quality management system, raising quality awareness among members of the firm, and creating a supportive and conducive climate for TQM implementation (Taylor, 1995; Tummala et al., 1996; Skrabec, 1999; Escanciano et al., 2001). Therefore, the implementation of the pertinent standard should be aligned with Total Quality Management implementation, to gain the maximum potential benefits derived from registration (Taylor, 1995; Tummala et al., 1996; Skrabec, 1999; Escanciano et al., 2001).

Based on that, Quality management techniques are characterised by being practical, implying skills, encompassing mechanisms, and they can be integrated to specific tasks (Fotopoulos and Psomas, 2009). In another context, attaining superiority in quality management is far perceived as imperative for any organization (Goharshenasan and Shahin, 2017).

Drawing on the above, total quality management in its environment was of great interest to both practitioners and scholars, since its salient role in firm's performance, cost, raising customer satisfaction, and loyalty thus maximizing profitability (Talib et al., 2011). Therefore, while implementing TQM, it is indispensable for firms to determine the key factors that must be given exceptional attention, to assure the successful adoption of the TQM (Trang and Do, 2020).

2.3.1 Total Quality Management definition

Loonam and Loughlin (2008) defined Total Quality Management as a management philosophy or style for enhancing the processes, and meeting consumer needs, and encompassing comprehensive analysis of both quantitative and qualitative methods; to continue enhancing quality in all the covered dimensions.

According to Zhengwei et al. (2019) Total Quality Management is the entire approach for the continuous development of products, services, equipment, procedures, atmosphere, and staff to fulfil consumer needs and reach the firm' maximum profitability.

In another definition, Total Quality Management encompasses policies, bylaws, and administrative approaches that pursues to entail the contribution of all the firm's members to increase productivity, by assuring customer and employee satisfaction (Ganapavarapu and Prathigadapa, 2015).

2.3.2 Total Quality Management Implementation importance

Total quality management derived its importance from being one of the concepts of contemporary management that aid to differentiate firms. This has led to the

endeavour carried by management in numerous organizations to apply these concepts and principles aiming to continuously enhance and boost performance to reach its utmost potential, and fulfil the needs and preferences of all stakeholders.

Therefore, TQM is perceived a strategic input, to improve production and deliver more services that are convenient to those stakeholders through ongoing improvement. TQM realizes that the focus should not be only on the output side, rather than giving an attentive emphasis to both inputs, and outputs through processes leading to create a competitive advantage to the firm and nurturing its success (Msallam et al., 2020).

It is quite noteworthy that the importance of quality management in business has raised significantly along the past decades and from a global perspective it urged investigating several countries to build a comprehensive understanding of TQM in the international context. Thus, TQM practices were found to exert a salient impact across both national and international levels, which assist firms to compete globally and acquire a competitive advantage in the international market (Salleh et al., 2018).

Total Quality Management call for creating a distinguished culture stemmed from the contribution of all firm's members to satisfy customers demands and preferences with the least cost, effort as well as time. This evidences that TQM has become crucially important to firms; by decreasing costs, raising productivity, promoting customer satisfaction, sustaining a competitive advantage and generating profits and high returns (Fernandes et al., 2017). Therefore, acquiring internationally recognized quality certificates will develop a strong reputation in the customers minds, as well as creating a common mission to target by all the firm members, nourishing a team spirit, and nurturing trust among them, which by

its turn will flourish those members' commitment to the firm (Zidane, 2010; and Saffar and Obeidat, 2020).

Empirical findings have shown that the way firms implement TQM have a direct impact on results and market performance. There are numerous forms describing TQM, and its importance lay on seeking for perfection, nurturing positive behaviours, and controls to avoid committing all potential errors, and promoting consumer service by enhancing productivity (Othman et al., 2020).

Along the years, TQM activities were established in a surge of literature that these activities positively enhance the firm's financial outcomes (Ganapavarapu and Prathigadapa, 2015; Talib et al., 2011; and Sadq, 2019). The findings of these studies have evidenced that total quality management systems have enhanced operational efficiency and firms with Quality Awards outperformed other non-awarded firms in their generated operating income (Othman et al., 2020).

In this vein, Powell et al. (1995) agreed that TQM is not only a management approach for producing better goods and services; but it is rather a mechanism that cater to enhanced efficiency and a more desirable competitive position. He highlighted the significant association between quality and productivity, which by its turn reduces wastage or reworks, that consequently improve quality and enhancing customer loyalty as well (Othman et al., 2020).

Particularly, there are numerous benefits that can be reaped from implementing TQM in a firm, which are as follow:

- Firm's growth, stability and flourishment (Issac et al., 2004).
- Practices that reflect senior management commitment, fulfilling customer needs, continuous improvement, staff engagement and enhanced

teamworking, and employees' empowerment to enable them feeling ownership for their decisions (Issac et al., 2004; and Fok et al., 2001).

- Enhancing competitive performance by raising "the quality of processes, products and services, people, and the culture of the firm" (Carroll, 1995).
- Problem-solving and predicting the future (Fok et al., 2001; and Moheel et al., 2019).

2.3.3 Relationship between success factors of TQM Implementation and TQM/firm's performance

Numerous studies reported a relationship between TQM in all of its forms and firms' performance (Prajogo and Sohal, 2006), these studies revealed that implementing TQM enhance firm's performance. "In the Malcolm Baldrige National Quality Award criteria", enhancing quality management practices has been shown to lead to more desirable outcomes (Evans and Dean, 2003; and Salleh et al., 2018).

In this vein, it is noteworthy to highlight that the importance of ranking the Critical Success Factors (CSFs) as a prerequisite to implementing TQM is attributed to cost reduction and the capacity to avoid defects, that by its turn, cater to the firm' success rate (Khanna et al., 2011). Drawing on this, having a comprehensive knowledge of Critical Success Factors by the firm's management will ensure such efficacious implementation of TQM. Therefore, serious endeavours and activities need to be exerted to assure the appropriate adoption of TQM, and to identify critical success factors affecting TQM implementation. According to Kalra and Pant (2013), failing to adopt TQM is because of ignoring quality standards in

assessing customer satisfaction, lack of supportive leadership, product quality and decline in employee morale (Halim, Azman and Malim, 2019).

Additionally, identifying critical success factors serve as an indicator of potential quality flaws and issues that may hurt long-term relationships with customers. Based on such premise, before implementing TQM, managers must have a thorough understanding of the business, its surrounding environment and the TQM success factors that can lead to higher quality of products and services (Salaheldin, 2009). Second, several studies have acknowledged barriers to the successful implementation of TQM, such barriers were found in numerous sectors like "manufacturing, services, government and education". Thus, it is crucial for all firms to comprehend and avoid these barriers before and within the implementation of TQM. According to Sebastianelli and Tamimi (2003), the common barriers to TQM implementation were five: insufficient development for both managers and employees, lack of quality planning, poor quality leadership, insufficient resources for TQM, and weak customer focus. Since many firms have been struggling to take initiatives in performance improvement in an environment characterized by fierce competition, essential processes and practices for direct performance improvement has emerged as a challenge put in face of many firms. This called for implementing Total Quality Management as a governing driver that can trigger the firm' performance improvement initiatives. The recent surge of studies in the TQM literature assessed the association between successful implementation of TQM and firms' performance. According to Kumar et al. (2009), a plethora of studies revealed a positive relationship between implementing TQM and improving firms' performance. Furthermore, Ng et al. (2014) concluded that empirical findings of prior studies provide robust support

for the influences of TQM on "product quality, process quality, customer satisfaction, and customer loyalty". Fotopoulos and Psomas (2010), assessed the relationships between TQM factors and firm's performance, and found that these factors greatly affect the performance of these firms with regard to "their internal procedures, their customers, their market share, and the social environment" (Mehralian et al., 2017).

2.4 Related Studies

This section shows all the related studies both regional and foreign that have investigated the research variables; Critical success factors and TQM implementation (expressed in terms of organizational performance).

2.4.1 Regional Studies

Al-Sabek (2015), has investigated the critical factors that affect the implementation of TQM in the construction sector in the United Arab Emirates (U.A.E). The study aimed to provide a better understanding of TQM and the implementation process among the U.A.E construction companies, and to assess the efficiency of the project outcome after the implementation. The study adapted a descriptive analytical approach through the use of a questionnaire that was distributed to 60 respondents in a construction company in Abu Dhabi.

The results revealed that management commitment and culture are the most influential factors in implementing TQM, in the investigated company. Additionally, the results showed that project cost was the highest outcome that yielded from the implementation of TQM.

Alotaibi and Islam (2013), have examined "the impact of Total Quality Management Practices and quality culture on the competitiveness of Saudi Contractors". The study aimed to "identify the impact of total quality management practices, quality culture -and their relationship with the competitiveness of Saudi Arabia contractors". The study adapted a descriptive analytical approach through the use of a questionnaire that was distributed to all Saudi Arabia Contractors to investigate the relationship between three variables: quality culture, TQM practices and competitiveness.

The results revealed that four total quality management practices "customers focus, process management, employee relations, management of supplier" have a positive significant impact on contractors competitiveness, while the other four TQM factors "education and training, information and analysis, continuous improvement, top management commitment" did not exert a significant impact on contractors competitiveness.

Baker, Ali and Onyeizu (2011), have investigated "Total Quality Management Practices in Large Construction Companies in Oman", where the study aimed to assess the effectiveness of TQM implementation by the large construction contractors in Oman. The study adapted a descriptive analytical approach through the use of a questionnaire that was distributed to 114 top managers in large construction companies in Oman.

The results revealed that most of the large construction companies in Oman are implementing the principles of TQM, and most of these companies workforce have a good knowledge and perception of TQM implementation, but it needs to be improved. Additionally, the results showed that teamwork is considered as the best

tool to implement quality, meanwhile it was revealed that there is a lack of training for both top and middle level managers. The study concluded that those company's employees are not provided with the opportunity to give their insights that can be used to boost the company's productivity.

Small, Ayyash and Al Hamouri (2017), have studied the benchmarking performance TQM Principals in Electrical Subcontracting in Dubai. The study aimed to conduct a comparison between the effects of TQM implementation against the traditional management style for electrical subcontracting, using a case study from Dubai. Both approaches were applied on two different areas on the same project. Data collection was based on the quantity installed, man- hours, and earned man-hours.

The results revealed that all electrical installations were completed within the time schedule on the side where the TQM was applied.

Al-Mannai et al. (2016), have studied "TQM implementation effect on Bahrain industrial performance". The study aimed to evaluate the extent of TQM implementation in Bahrain industrial sector, in order to identify the critical factors for the successful TQM implementation in terms of performance.

The study adapted a descriptive analytical approach through the use of two questionnaires; strategic and operational that were distributed in 39 large and medium size industrial firms in Bahrain, to assess the degree of TQM application, as well as level of organizational performance of these firms. The strategic level questionnaire was distributed to the top management of the surveyed industrial and it includes 6 success factors namely; "Leadership, Focused Improvements,

Information and Feedback, Employee Participation, Employee Satisfaction, and Supplier Quality". On the other hand, the operational questionnaire was distributed to employees at these companies and it encompasses 10 success factors. The results revealed that TQM implementation is properly established in the surveyed organizations, and reflected the awareness of top management towards the significance of TQM program implementation. Additionally, the results showed that the degree of TQM implementation among the participant organizations was 92%, and the quality tool which was commonly used was Plan Do Check Act (PDCA). The study concluded that TQM implementation reflected its positive impact in the improvement of the organizational performance.

Nair and Choudhary (2016), have examined the influence of critical success factors of total quality management on financial and non-financial performance of hospitality industry. The study aimed to focus on the influence of critical success factors of total quality management on the financial and non-financial performance in the hospitality industry in Qatar. The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to 331 managers of hospitality industry in Qatar.

The results showed that "Top management leadership, Organizational learning, Quality information management, and Supplier management have exerted positive significant impact on either financial or non-financial performance. The study concluded that these dimensions were found to be critical in the hospitality industry.

Salaheldin et al. (2015), have investigated "the critical success factors for total quality management implementation in Jordanian healthcare sector". The study aimed to examine the role of creativity and innovation on the critical success factors of total quality management TQM implementation in the Jordanian healthcare sector. The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to 292 healthcare managers working at six different Jordanian hospitals.

The results showed that there is a statistically significant difference between the various patterns of creativity and innovation in terms of the critical success factors of TQM implementation. Moreover, the study revealed a positive and significant impact of the patterns of creativity and innovation on the critical success factors of TQM implementation. The study concluded that from comparing different patterns of creativity and innovation of healthcare managers in these hospitals that all the investigated factors were found critical for successful TQM implementation, particularly leadership and support from top management, continuous improvement, involving suppliers in improvement activities, proper training for employees, and conducive work environment and culture that embrace quality.

Al-Jalahma and Gallear (2010), have explored "the relationships between core elements of TQM implementation", where the research aimed to examine the relationship between set of variables that affect the effectiveness of TQM implementation". The examined variables are "the Principals of TQM, organizational culture and the strategies" used to overcome TQM barriers to facilitate a successful TQM implementation. The study adapted a descriptive analytical approach through the use of a questionnaire that will be distributed to

different type of service organizations in Bahrain (banks, communication services, and other private firms).

The study highlighted that the high rate of failure (60% to 67%) in the implementation of TQM in business around the world might be attributed to incorrect application of TQM basic principles, or due to the absence of appropriate cultural or lack on the implementation strategy. Additionally, the study has reported that previous studies have investigated TQM variables separately, thus, the study has suggested a holistic approach that endeavours to examine these relationships collectively to create a comprehensive TQM implementation model.

Ahmed and Taib (2019), have studied "the effect of critical success factors of quality management to excellence in Iraqi Universities". The study aimed to assess the impact of critical success factors to excellence in Iraqi universities. The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to 174 of the head of departments in six Iraqi universities.

The results revealed that critical success factors have a positive statistical significant impact on excellence. Particularly, the findings showed that top management commitment exerted the highest statistical significant impact on higher education excellence. This was attributed to that top management's vision was mainly emphasizing on quality improvement, and the leadership styles practiced in these universities were highly oriented towards engendering quality improvement. Additionally, human resource development and strategic planning were found to have a positive significant statistical impact on the studied universities' excellence. Despite that, the results showed that customer focus didn't have a significant statistical impact on these universities' excellence. This may be

attributed to the lack of clarity of the customer's role in Iraqi universities, in terms of how to deal with those customers who are not only students (i.e parents, alumni). Furthermore, the findings revealed that management of process did not have a significant statistical impact on education excellence in those universities. Quality Information did not have a significant statistical impact on education excellence that can be attributed to lack of valuable information and the limited use of quality tools needed to acquire pertinent information that leads to the quality' improvement. The result concluded that these proven success factors with positive significant impacts have heavily contributed to the higher education excellence in Iraqi universities.

Salama and Swareldahab (2019), studied the "Critical Success Factors of Total Quality Management and Private Universities Performance in Sudan, the case of Ahfad University for Women". The study aimed to determine the Critical Success Factors (CSFs) of TQM practices that impact the university performance.

The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to 94 academic staff in this university. The results showed that there is a significant positive direct relationship between CSFs of TQM and the organizational performance of this university. Moreover, the findings revealed that organizational culture was the highest factor impacting this university' performance. Following, continuous improvement was found to be the second influential factor on this university' performance. Additionally, employees' awareness with TQM was found to have a statistical significant impact on organizational performance. The study concluded that the reaped benefits acquired

by those academic staff contributed positively to the enhanced university performance.

Nadim and Al-Hinai (2016), have investigated the critical success factors of TQM in Higher Education Institutions Context. The study aimed to review (TQM) extant literature relevant to higher education sector, to discover numerous research instruments for investigating quality assurance in higher education, and to identify the critical success factors in this sector, in Oman. The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to 100 from both academic and administrative staff at College of Applied Sciences, Muscat, Sultanate of Oman.

The results revealed that employees involvement was the factor that exerted the highest significant impact, followed by stakeholder focus. The study concluded that all the all the studied constructs are crucial in building privileged quality culture in this college.

2.4.2 Foreign Studies

Elghamrawy and Shibayama (2008), have investigated "the total quality implementation in the construction industry", where the study aimed to assist the Egyptian contractors to the effective TQM implementation by introducing the effective steps using a new model for TQM implementation that is suitable for the construction industry in Egypt. To achieve this aim, a comparison was conducted between two construction firms working in Egypt, one is a local Egyptian contactor and the other is a Japanese contractor working in Egypt. Detailed questionnaires followed by interviews to the managers of each firm were used, to

find the obstacles that the Egyptian construction industry is facing in applying quality policies and assess the process of TQM implementation of each firm.
The study recommended a new TQM implementation model that emphasize on the following: rearranging the structure of the organization to be prepared for the new changes followed by action plan of implementation, provide training on TQM to all employees, promote the teamwork by breaking down the barriers, improve the way of thinking like brainstorming, improve the quality of the job work, measure the TQM implementation process.

Kaur, Singh and Singh (2019), have studied "the synergetic success factors of total quality management (TQM) and supply chain management (SCM). The study aimed to address the critical factors for total quality management (TQM) and supply chain management practices, and to identify the relationships among them in the manufacturing sector in India. The study adopts a review of literature on practices of TQM and SCM applied in different firms in India.
The study presented a set of six critical factors "top management commitment, employee involvement, customer focus, training and education, process management, supplier management, and continuous improvement". The results revealed that "management support and commitment, customer focus, information, and supplier partnership" are the most common TQM and SCM practices. The study concluded that integrating TQM and SCM along the supply chain was the most influential on the organizational performance.

Subramani et al. (2019), have investigated "the relationship between critical success factors of total quality management implementation (top management

commitment, customer focus, strategic planning, process management, people management, leadership, and supplier management) and business performance". The study aimed to investigate the relationship between critical success factors of total quality management implementation and business performance manufacturing firms in India. The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to 818 employees of 235 manufacturing firms in India.

The results showed a significant positive relationship between total quality management practices and business performance. The findings revealed that these seven critical success factors play a salient role in identifying the success of quality management practices. The study recommended that managers in manufacturing firms have to consider the critical success factors, while designing and adopting TQM.

Yazdani, Soukhakian and Mozaffari (2014), have investigated "the critical success factors in total quality management implementation and prioritization in Pars Oil and Gas Company in Iran". The study aimed to answer two main questions: "what critical success factors in the implementation of Total Quality Management are proposed in Pars Oil and Gas Company based on the Malcolm Baldrige model? and What is the priority of critical success factors in the implementation of Total Quality Management based on different levels of management`s perspective". The study adapted a descriptive analytical approach through the use of questionnaire that was distributed to 51 Managers from different managerial levels in the company.

The results showed that leadership, strategic planning, and customer focus were the highest ranked factors by the respondents. The study concluded that Malcolm Baldrige model encompasses many features to assess the performance of business organizations.

Goharshenasan and Shahin (2017), have studied the "prioritisation of quality management principles based on critical success factors of TQM using integrated approach of MCDM and IPA - the case of Marjan Tile Company". The study aimed to propose a framework for categorizing eight quality management principles in ISO 9001:2008, drawing on the critical success factors of TQM. The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to 13 process owners of Marjan Tile Company in Iran.

The results showed that four factors were found as predictors of quality assurance; "systemic approach in management; employees' involvement, process approach, continuous improvement; leadership; and realistic approach in decision making". The study concluded that Lack of a strategy for enhancing the performance of a principle entails that this principle is dealt as weak by importance performance analysis (IPA). The study also concluded that by using process analysis, such as Malmquist index, changes occurred in the processes of the firm can be evaluated and needed improvement, can be adopted regularly. The study recommended that to improve the performance of each quality principle, quality circles could be formed and balance scored card (BSC) or cause and effect diagram might be applied.

Jusoh et al. (2018), have studied the" Application of MCDM approach to evaluate the critical success factors of total quality management in the hospitality industry". The study aimed to identify and assess the TQM critical success factors in hospitality industry in Malaysia. The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to 14 Quality Management experts working in the hospitality industry with minimum 10 years of experience, as a quality manager and TQM manager in Malaysia.

The results showed that internal and external cooperation was the highest ranked factors among those factors in the hospitality industry, followed by customer focus and leadership. The study concluded that the findings have showed guidance to the firm's quality managers, which in turn helped them in the implementation of TQM in these hotels effectively. The study recommended that practitioners can deploy the suggested approach to assess the firm's quality level and compare the findings of this current study with the used methods in previous research.

Kumar and Sharma (2017), have conducted "An empirical investigation of critical success factors influencing the successful TQM implementation for firms with different strategic orientation" in India. The study aimed to undertake a "comparative analysis of the significance of 20 TQM CSFs to the strategic choices of the firms such as innovators, prospectors, and defenders". The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to 111 firms in India. The results showed that the CSFs is crucially important for several firm's strategies.

The findings revealed that "SQM, interface management, customer focus, communication of information, operating procedures, zero defects, technology

utilization, service quality, and innovation are important CSFs for innovators than prospectors and defenders". The study concluded that quality tools and techniques and cultural change did not impact the successful TQM implementation in the investigated firms. The study concluded that due to the fierce competition and economic pressures, top management has realized the vitality of adopting TQM practices leading to better quality, while increasing cost control, that by its turn strengthen its competitive advantage. Additionally, the study concluded that in case there is a incongruity between strategy and CSFs with TQM practices, the smooth operation of the firm might be interrupted. The study recommended that the 20 CSFs might be used as guiding dimensions that lead to effective implementation of TQM.

Zylfijaj and Pira (2017), have conducted an "Assessment of critical success factors of TQM culture in hospitality sector in Kosovo". The study aimed to demonstrate how managers and staff of a 5-star hotel in Kosovo perceive quality. Additionally, it explores the critical success factors related to TQM culture, and how they are integrated in the hotel operations. The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to hotel's managers as well as employees in a 5-star Hotel in Prishtina, Kosovo.

The study showed that the critical success factors "leadership, customer focus, and training, communication, teams and staff empowerment" generate several advantage for the 5-star hotel operations that impact the quality of service of this hotel. The study concluded that some of the TQM aspects are applied in the investigated hotel and particularly, the TQM culture is well recognized in this hotel. Additionally, the study concluded that the common understanding from both

managers and employees' perspectives is that quality is directly attached with customer focus. Surprisingly, the most contradictory understanding is associated to employee empowerment as manages do not perceive staff empowerment as an added value, while employees believe that this factor is directly attached to work motivation that by its turn enhance service quality. Other critical success factors, like "leadership, customer focus, teams, training and communications are commonly seen as critical success factors that directly relate to the TQM implementation". The study concluded that some of the critical success factors are directly associated with TQM, while other factors are less linked to it.

Bouranta et al. (2017), have examined the critical determinants of TQM and their impact on company performance. The study aimed to identify the latent factors of total quality management (TQM) practices, and their impact on company performance outcomes in the Greek hotel industry. The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to 153 top-and middle-level hotel-quality managers.

The results revealed that most of the TQM elements "quality practices of top management, strategic quality planning, employee quality management, customer focus and employee knowledge and education" are considered as predictors of hotel business performance. The study concluded that financial performance, customer focused performance, and service quality performance were the highest indicators driven by these factors. In another word, TQM elements were considered as antecedents of hotel business performance.

Matsoso and Benedict (2015), have investigated "the critical success factors towards the implementation of total quality management in small medium enterprises in Cape Town in South Africa. The study aimed to identify the extent to which SMEs apply TQM in their activities. The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to 156 SMEs.

The results showed that SMEs that adopted TQM in their operations were more successful than those that did not; management of customer relations was the most important critical success factor in all SMEs, while improving the quality of products was the most significant performance measure in the investigated SMEs. The study concluded that management of customer relations was the most important critical success factor in all SMEs.

Danyen and Callychurn (2015), have examined "Total quality management success factors and their relationships with performance measures in the food industry". The study aimed to determine the required factors for a successful implementation of a total quality management programme in the food manufacturing sector in Mauritania and to assess their impact on operational, quality and business performances. The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to 92 food manufacturing companies with medium to large scale in Mauritius.

The results revealed that customer focus was the highest TQM factor practised in these companies. The study concluded that all the critical success factors were found important for the ideal quality implementation.

Dubey et al. (2015), have investigated "the mediating effect of human resource on successful total quality management implementation". The study aimed to test "the mediating effect of human resource between independent variables (i.e. leadership, quality culture (QC), and successful total quality management (TQM) implementation for firm performance as dependent variable". The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to 275 firms in Indian Industries.

The results showed that HR fully mediates the relationship between leadership and successful TQM implementation for firm performance, while quality culture has exerted significant direct impact on firm performance without any mediation effect of HR. The study concluded that top management commitment impacts employee's attitude that by its turn enhance the TQM implementation. Moreover, the study concluded that quality culture has played a salient role on successful TQM implementation for firm performance, without the mediating role of HR practices in the studied firms. This is a unique contribution to the study. The study concluded that Mediation regression has its own limitations. Satisfying four steps does not, however, conclusively establish that mediation has occurred and also there persists a measurement problem.

Utam and Harahap (2018), have examined "the critical success factors of total quality management and their impact on performance in the Indonesian public service sector". The study aimed to examine the relationships among critical success factors of TQM and performance outcomes within one Public Service Sector in Indonesia from both employee and managers perspectives. The study

adapts a descriptive analytical approach through the use of questionnaire that was distributed to 310 employee and managers working in this sector.

The results showed that most influential factor on performance is the leadership factor, followed by customer focus and internal and external cooperation. The results concluded that continuous improvement, customer focus, and operational performance contributed massively in improving the quality of product/services in the studied sector. The study recommended that managers in these public organizations has to consider leadership as an imperative to assure effective quality improvement.

Bouranta, Psomas, Suárez-Barraza and Jaca (2019), have examined "The key factors of total quality management in the service sector". The study aimed to determine the key TQM factors and their impact on internal and external customer performance measures across different countries. The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to three countries (131 from Greece, 70 from Mexico and 151 from Spain).

The results showed that the determined key TQM factors are common across the three studied countries; "top management' quality practices, process management, employee quality management, customer focus, and employee knowledge and education". Despite that the adoption extent of these key factors differ across service firms within these countries. The results revealed that some TQM elements predict customer- and employee-focused performance. The findings revealed that employee knowledge and education was particularly associated with employee-focused performance in Greece and Mexico. Unexpectedly, only in the case of Spain employee quality management exerted a positive significant impact on

employee-focused performance. The study concluded that the three countries are distinct from one another regarding the relationships between TQM factors and performance indicators.

Suleman and Gul (2015), have studied the challenges to successful total quality management implementation in public secondary schools in Pakistan". The study aimed to explore the challenges encountered by public secondary schools in terms of the successful implementation of total quality management. The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to 25 heads and 75 secondary school teachers selected from 25 public secondary schools in Pakistan.

The results showed that public secondary schools encounter several challenges in the implementation of TQM. The results revealed that lack of effective leadership, lack of funding, lack of management commitment, poor and ineffective planning were the key challenges encountered by public secondary schools in implementing TQM. The study concluded that ineffective leadership has led to failure in the total quality management implementation.

Salleh et al., (2018), have investigated "the critical success factors of total quality management implementation in higher education institution". The study aimed to identify the critical success factor of total quality management (TQM) implementation in higher education in Malaysia. The study adapts a descriptive analytical approach through the use of questionnaire that was distributed to staffs from 99 Faculty Office and Administrative Office of Universiti Technology Malaysia (UTM).

The results showed a statistical significant positive relationship between TQM critical success factors and performance measurement. The findings revealed that staff commitment, customer focus and mission achievement were established as predictor for TQM implementation. The study concluded that the implementation of TQM has improved the performance measurement. Moreover, it was concluded that UTM staff possess high commitment that trigger them to participate actively in their university's activities. The study recommended decision makers in the university to monitor how the implementation process contributed effectively toward TQM. Furthermore, the study recommended that future research to be undertaken to explore the level of effectiveness and the extent of successful TQM implementation in other industries.

2.5 Literature Summary

Drawing on the review of related research mentioned in the previous literature that studied the two investigated variables; critical success factors of TQM and organizational performance. It is quite notable that these studies differ in terms of the context where they were conducted in Iraq, Sudan, Dubai, Bahrain, Oman, Qatar, United Arab Emirates, Jordan, Saudi Arabia, Egypt, Greece, Mexico, Spain, India, Malaysia, Indonesia, Iran, Kosovo, South Africa, Mauritania and Pakistan.

Despite the fact that these studies relied on the descriptive analytical quantitative approach, they differed in their aims, the study population, and the study sample, thus, they revealed different findings. Based on this premise, it is imperative to discuss what was revealed in these studies as follow:

(A)- The results revealed by these studies

- The related studies have agreed on agreement in terms of a positive significant relationship between TQM critical success factors and TQM implementation in terms of organizational performance (Salama and Swareldahab, 2019; Al Mannai et al., 2016; Subramani et al., 2019; Salleh et al., 2018).
- The results revealed a consensus in terms of significant impact of critical success factors on TQM implementation expressed in organizational performance (Ahmed and Taib, 2019; Salama and Swareldahab, 2019; Al Mannai et al., 2016; Nadim and Al-Hinai, 2016; Nair and Choudhary, 2016; Al-Sabek, 2015; Alotaibi and Islam 2013).
- The results of these related literature showed a variation in terms of which critical success factor was the highest influential on the TQM implementation expressed in the organizational performance as follow:
  - In terms of Leadership/ Top management commitment; several studies found it as among the most influential critical success factors that exerted a positive significant impact on organizational performance (Ahmed and Taib, 2019; Kaur et al., 2019; Jusoh et al., 2018; Utam and Harahap, 2018; Bouranta et al., 2017; Goharshenasan and Shahin, 2017; Zylfijaj and Pira, 2017; Nair and Choudhary, 2016; Al-Sabek, 2015; Yazdani et al., 2014**;** Alotaibi and Islam 2013)
  - In terms of Policy and Strategy/ Strategic Planning; several studies found it as among the most influential critical success factors that exerted a positive significant impact on organizational performance (Ahmed and

Taib, 2019; Salleh et al., 2018; Bouranta et al., 2017; Goharshenasan and Shahin, 2017; Yazdani et al., 2014)

- In terms of Measurement and Feedback/ Customer focus; several studies found it as among the most influential critical success factors that exerted a positive significant impact on organizational performance (Kaur et al., 2019; Jusoh et al., 2018; Utam and Harahap, 2018; Salleh et al., 2018; Kumar and Sharma, 2017; Bouranta et al., 2017; Zylfijaj and Pira, 2017; Danyen and Callychurn, 2015 ; Matsoso and Benedict, 2015**;** Yazdani et al., 2014; Alotaibi and Islam 2013), surprisingly one study did not find a significant impact of this factor on organizational performance (Ahmed and Taib, 2019)
- In terms of Management of process; several studies found it as among the most influential critical success factors that exerted a positive significant impact on organizational performance (Goharshenasan and Shahin, 2017; Kumar and Sharma, 2017; Alotaibi and Islam 2013), surprisingly one study did not found a significant impact of this factor on organizational performance (Ahmed and Taib, 2019)
- In terms of quality information; several studies found it as among the most influential critical success factors that exerted a positive significant impact on organizational performance (Bouranta et al., 2019; Salama and Swareldahab, 2019; Kaur et al., 2019; Bouranta et al., 2017; Zylfijaj and Pira, 2017; Nair and Choudhary, 2016; Dubey et al., 2015; Alotaibi and Islam 2013; Baker et al., 2011), surprisingly one study did not found a significant impact of this factor on organizational performance (Ahmed and Taib, 2019).

- In terms of organizational culture/ work environment and culture; several studies found it as among the most influential critical success factors that exerted a positive significant impact on organizational performance (Salama and Swareldahab, 2019; Jusoh et al., 2018; Utam and Harahap, 2018; Salleh et al., 2018; Goharshenasan and Shahin, 2017; Kumar and Sharma, 2017; Zylfijaj and Pira, 2017; Al-Sabek, 2015).
- In terms of continuous improvement; several studies found it as among the most influential critical success factors that exerted a positive significant impact on organizational performance (Salama and Swareldahab, 2019), surprisingly one study did not found a significant impact of this factor on organizational performance (Alotaibi and Islam 2013)
- In terms of Resources Management; one study found it as exerting a positive significant impact on total quality management implementation (Dubey et al., 2015).
- In terms of subcontractors and suppliers' quality management; several studies found it as among the most influential critical success factors that exerted a positive significant impact on organizational performance (Kaur et al., 2019; Kumar and Sharma, 2017; Nair and Choudhary, 2016; Alotaibi and Islam 2013).
- In terms of education and training; several studies found it as among the most influential critical success factors that exerted a positive significant impact on organizational performance (Bouranta et al., 2019; Bouranta et al., 2017; Zylfijaj and Pira, 2017), surprisingly one study did not found a

significant impact of this factor on organizational performance (competitiveness) (Alotaibi and Islam 2013).

Table 2.1 list the **Success Factors** of TQM Implementation used in the questionnaire design based on previous studies.

(B)- Benefits from previous related studies

1. The previous studies represented the road map on the basis of which the research problem was formulated in light of its background in the literature reviewed.
2. Selecting the dimensions that reflect the most prevailing studied critical success factors in the previous related studies, in order to build on the findings of these researches, thus a more holistic picture will be generated.
3. Discussing the results of this current study by linking its findings with the results of these studies.

(C) - What distinguishes the current research

Even though, there is a surge of research has studied the impact of critical success factor on Total Quality Management Implementation, few studies have explored the barriers and benefits of successful TQM implementation. Therefore, by revealing the respondent's perceptions, particularly those employees working in the operation, this research will be distinguished than prior researches as it will contribute in providing a better understanding on what obstacles might hinder successful TQM, as well as the potential benefits that might be gained from such successful implementation.

Table 2.1 Success Factors of TQM in previous studies

No.	Author	Year	Dimensions								
			Leadership	Continuous improvement	Measurement and feedback	sub-contractors and supplier quality management	Process management	Policy and Strategy	Resource Management	Education and Training	Work Environment and Culture
	Regional Studies										
1	Ahmed and Taib	2019			✓		✓	✓	✓		✓
2	Salama and Swareldahab	2019		✓							✓
3	Small et al.,	2017									
4	Al Mannai et al.,	2016	✓		✓						
5	Nadim and Al-Hinai	2016			✓						
6	Nair and Choudhary	2016	✓			✓			✓		
7	Al-Sabek	2015									✓
8	Salaheldin, Fathi and Shawaheen	2015	✓	✓		✓				✓	✓
9	Alotaibi et al.	2013	✓	✓	✓	✓	✓		✓	✓	✓
10	Abu Baker et al.,		✓							✓	✓
11	Al-Jalahma and Gallear	2010						✓			✓
12	Elghamrawy and Shibayama	2008		✓				✓		✓	✓

Foreign Studies											
13	Bouranta, Psomas, Suárez-Barraza and Jaca	2019	✓		✓	✓	✓			✓	✓
14	Kaur, Singh and Singh	2019	✓	✓	✓	✓	✓		✓	✓	
15	Subramani, Jan, Arumugam and Sasikala	2019	✓		✓	✓	✓	✓	✓		
16	Jusoh, Mardani, Omar, Štreimikienė, Khalifah and Sharifara	2018	✓		✓						
17	Salleh et al.,	2018	✓		✓			✓			
18	Utam and Harahap	2018	✓	✓	✓		✓				
19	Goharshenasan and Shahin	2017	✓	✓			✓	✓	✓		
20	Kumar and Sharma	2017	✓		✓						
21	Zylfijaj and Pira	2017	✓		✓				✓	✓	✓
22	Bouranta, Psomas and Pantouvakis	2017	✓		✓	✓		✓		✓	
23	Matsoso and Benedict	2015			✓	✓					
24	Danyen and Callychurn	2015			✓						
25	Dubey, Singh and Ali	2015	✓								✓
26	Suleman and Gul	2015	✓					✓			
27	Yazdani, Soukhakian and Mozaffari	2014	✓		✓			✓			
Total			**18**	**7**	**16**	**8**	**7**	**9**	**7**	**8**	**11**

2.6 Chapter Summary

This chapter dealt with the success factors for TQM implementation, definition and importance of TQM, conceptual/ theory building TQM, dimensions of success factors of TQM implementation, then an introduction to TQM management, importance of TQM implementation and the related studies being local or foreign that have investigated the same variables.

Based on the findings and the analysis extracted, the current study investigation road map, and execution strategy is planned.

CHAPTER 3
Research Methodology, Data collection and Questionnaire Design

3.1 Introduction

3.2 Research Methodology

3.3 Data collection

3.4 Questionnaire design and development

3.5 Questionnaire distribution

3.6 Chapter Summary

Chapter 3
Research Methodology, Data Collection and Questionnaire Design

3.1 Introduction

The term Research Methodology, as stated by Kothari (1990) “is a way to systemically solve the research problem”.

This chapter describes the methodology deployed in the research in the pursuit for data collection, including the approach for data collection, research tools, questionnaire design, and development. Furthermore, this chapter provides an exhaustive explanation to the process pertinent to data measurement in terms of Likert scale, relative importance index (RII) of TQM Implementation, questionnaire distribution in terms of population, and sample size.

3.2 Research Methodology

This section encompass the methodological perspective pursued by the research and it encompasses the research approach, the research purpose, research type, research tools, and research plan.

3.2.1 Research Approach

Data can be classified according to their characteristics to **Quantitative Data** and **Qualitative Data,** with respect to the way of collecting, recording, and analyzing the data (Walliman, 2011).

- **Quantitative Data:** Data can be explicated in terms of numbers, for instance frequencies or percentages, depending on proper statistical

techniques are to analyze these numbers (Kothari, 1990). Quantitative researches are characterized by being structured and rigid, applied onto a substantial sample size and aimed to interpret incidents, opinions and attitudes, or formulate theories (Kumar, 2011).

- **Qualitative Data:** Data can be illustrated as words like ideas, feelings, and tenets (Walliman, 2011). It relies on subjective assessment of attitudes or behaviors (Kothari, 1990). Thus, qualitative researches are unstructured and far more flexible, applicable on fewer cases, and aimed to describe a phenomenon, situation or issue by exploring experiences, feelings, and perceptions (Kumar, 2011). As words cannot be expressed mathematically, so different techniques are used for analysis, such as qualitative (Walliman, 2011).
- **Mixed Methods:** refers to incorporating both qualitative and quantitative data, thus exhibited in both numbers and words. This combination enriches the research with comprehensive outcomes (Mohajan, 2017).

This current study is using **Mixed Methods**, as the research involves collecting, analyzing, and integrating quantitative data into a qualitative format to give further explanations to qualitative data, consequently reaching a more holistic assessment.

3.2.2 Purpose of the Research

Pinsonneault and Kraemer (1993) stated that the most common and useful purposes of researches are as follow:

- **Exploration**: used to develop concepts and methods for more details, discover new possibilities, and dimensions in a selected area. This type of study focuses on a wide number of population that have common interest

on a particular topic or a common situation, to extract their point of views in a flexible manner.

- **Description**: focuses on facts occurred in a phenomenon within a selected population. It is used to describe the distribution in different situations, events, attitudes or opinions, and conduct comparisons.
- **Explanation**: used to test the relationships among variables that relied on cause and effect pattern, to reveal whether there is a relation among these variables and the reasons that lay behind them.

This study pursues a combination of **Descriptive and Explanation** research approach since it measures, evaluates, and assesses an existing process on a selected population and figure out the barriers that impede, it in pursuit for development.

3.2.3 Research Type

According to Igwenagu (2016), researches can be classified based on the method deployed and research goals as follow:

- **Action research**: A type of research pertinent to investigating processes, in order to incorporate the changes required to improve the effectiveness or to solve an existing problem.

- **Creative research**: A type of research relevant with new theories, procedures, and innovations. It is characterized as less structured and cannot be preplanned.

- **Descriptive research**: A type of research that focuses on studying a particular situation in a certain case study that leads to discovering a new theory.

- **Experimental research**: A type of research that is concerned with science. Experiments are conducted to study the effect of changes on dependent variables.

- **Ex-post facto research**: A type of research pertinent with studying the data produced from the experimental research. It studies how an existing independent variable affects a dependent variable.

- **Expository research**: A type of research deployed in reviewing existing information. Thus, points of views in a certain domain are compared, contrasted and an analyzed to generate new perceptions.

- **Historical research**: A type of research that relies on applying past incidents in a present situation to predict future situations.

This study is rather considered as an **Action research,** which aims to investigate a process to incorporate the necessary changes, to enhance the effectiveness of the processes.

3.2.4 Research Tools

It is important to select the appropriate way of collecting data with respect to the nature of the research, objectives, time available, and degree of accuracy required (Kothari, 1990). The most common methods of data collection are as follow:

1. **Survey**: stands for collecting data related to practices or situations from one point of view within a time point for a specific selected population, through the use of a Questionnaire (Igwenagu, 2016).

2. **Interviews**: refers to the way of communicating and collecting data directly by an interviewer, by conducting personal interview, either being face-to-face or telephone (Crawford, 1997).

Figure 3.1 illustrates the types of interviews carried on by the two types of researches; quantitative versus qualitative (figure 3.1).

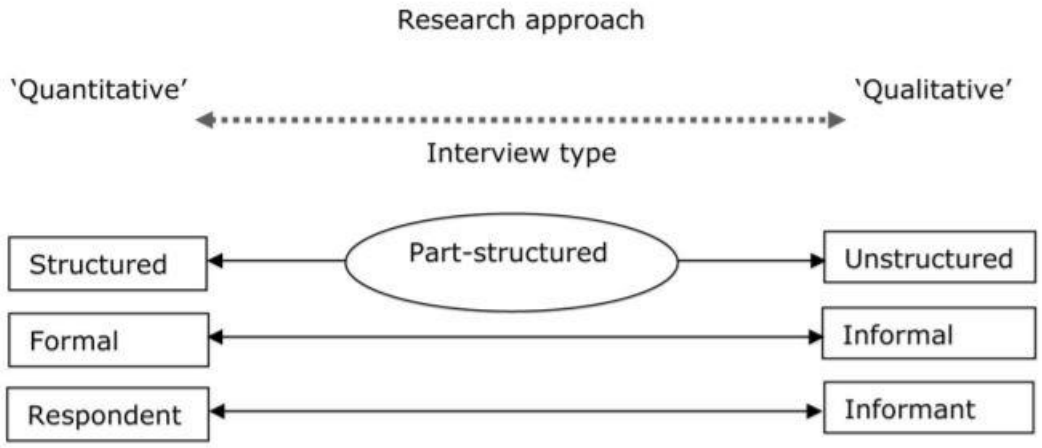


Figure 3.1

Common types of interviews (Hobson and Townsend, 2010)

- Structured interview: refers to interviewers following specific questions and answers, whether these answers are open ended and close ended questions. Thus, questions pursue a certain pattern entailing a smooth flow and coherence to ensure a clear structure. These interviews are mostly used in the quantitative or mixed methods researches and they are considered a

relatively rigid instrument, as it bounds the interviewer from changing, removing, or adding any questions (Crawford, 1997).

- Semi-structured interviews: stands for preparing a list of questions from the interviewer who furnish a conversation that might take numerous directions randomly, so both interviewer and interviewee are freeing up from a bounded discussion. It allows the interviewee to express his/her thoughts and feelings with far flexible responses, thus, more in-depth answers are articulated (Clifford, French and Valentine, 2010).

- Unstructured informal interview: Where informal type of questions and answers are deployed in a conversation between the interviewer and interviewee, aimed to generate ideas in the preliminary stage of the research. Thus, there are no specific questions that are set earlier, therefore the interviewer is not controlled by a specific situation. This type of interviews is mostly used in qualitative research (Crawford, 1997).

1. **Questionnaire** is a set of questions that follow a certain sequence and has a specific answer format (written or oral) that is designed to measure attitude or behavior in a human activity. Table 3.1 illustrates the types of questionnaires deployed for different studies.

Table 3.1

Types of Questionnaires for different studies

Type of Study	Questionnaire Type	Type of Administering
Large, quantitative studies	Structured	Telephone Face-to-face Self-completion

Business to business studies; investigative consumer studies	Semi-structured	Telephone Face-to-face
Qualitative studies	Unstructured	Depth Telephone Face-to-face Focus groups

Types of questionnaires:

1. **Structured questionnaire:** contains number of closed-ended questions with answers decided in advance. It can be accomplished using telephone, face to face or self-completion, depending on the nature of the research, respondents, and circumstances.

2. **Semi-structured questionnaire**: a mix of unstructured and structured questionnaires that encompasses both closed and open-ended questions. It allows collecting mixture of qualitative and quantitative data. It can be accomplished using telephone or face-to-face.

3. **Unstructured questionnaire**: encompasses open-ended questions, where the conversation entails the interviewer to formulate new questions based on the respondents. It can either be conducted through the use of in-depth telephone conversation or face-to-face.

4. **Case Study**: It is implemented at a small scale to describe the relationships in an existing phenomena or study.

5. **Simulations:** It refers to data extracted from prior established system within certain conditions for the purpose of modeling and exploring errors.

In this current study, the **Interview method** is deployed to collect the *preliminary data*. Face-to-face/phone interviews with experts were conducted to comprehend profoundly the dimensions of those experts' expertise and perceptions. This technique encompasses numerous advantages; like avoidance of time consuming, clear responses, and in-depth acquired information.

In the next stage of data collection, **Questionnaires** are used to collect ***primary data*** directly from a defined targeted sample. It is noteworthy, that close-ended questionnaires provide easiness within the stage of data analysis.

This method is deployed as it allows gathering information from a large number of population and obtaining a substantial amount of data quickly. It is noteworthy that both questionnaires; strategic and operational were designed from scales in previous studies, in addition to the experts' opinion interviews that their insights were integrated with the items adopted from previous studies, thus both surveys were developed.

3.2.5 Research Plan

Research Plan is the phases that the researcher will pursues to achieve the research objectives (Mishra and Alok, 2017). Figure 3.2 illustrates these phases in stages form. It encompasses a number of related stages as follow:

Stage 1: Identify research problem and objectives

Stage 2: Review the literature and extract the relevant information to achieve the research objectives from these related studies.

Stage 3: Identify the targeted population and sample (Bahraini Contractors)

Stage 4: Contact the related authorities and firms to gather the needed information regarding contractors

Stage 5: Collect research data through interviews with experts and questionnaires.

Stage 6: Analyze the data collected using appropriate statistical tools; Descriptive statistics, inferential statistics analysis, and Regression analysis.

Stage 7: Discuss the results, compare it with the major findings of previous studies, and present the recommendations.

Stage 8: Develop a forecasting model for the ideal implementation of TQM in the mega contractors in Bahrain.

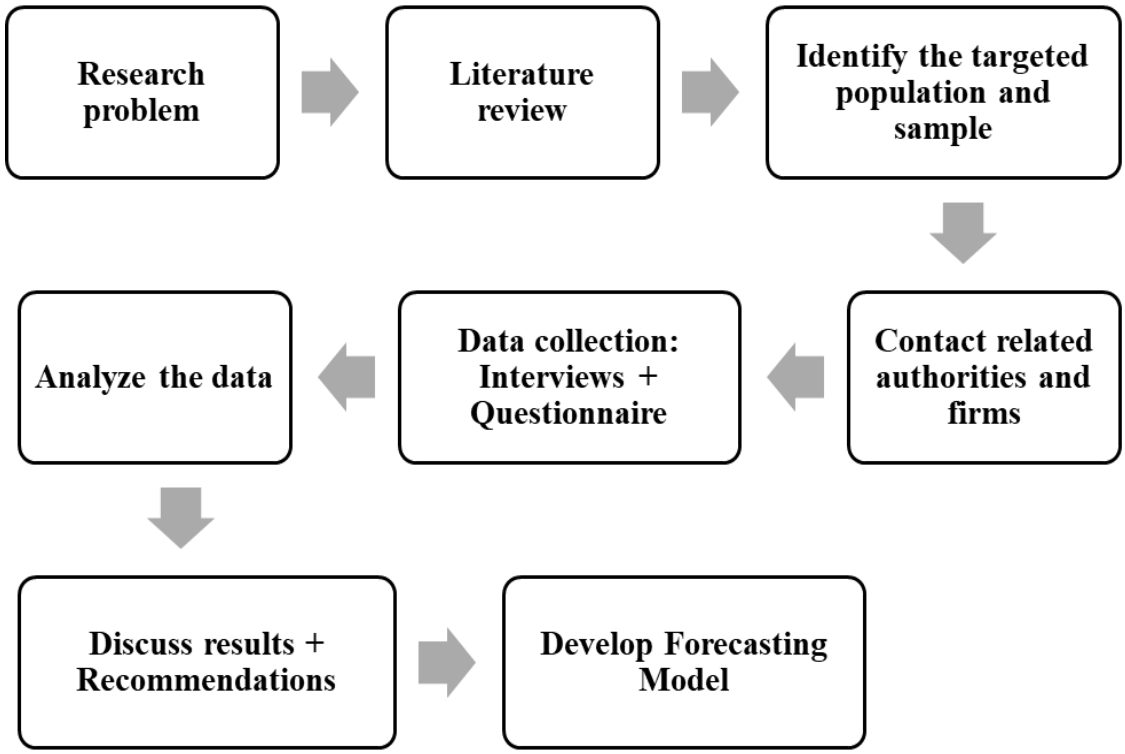


Figure 3.2

Research plan

3.3 Data Collection

The aim of the data collection in this research is to determine which success factor is the most critical within the TQM implementation process from the perspectives of the surveyed respondents.

3.3.1 Approach to Data Collection

To determine an effective forecasting model that leads to achieving a high level of efficiency in the implementation of TQM, in the construction of mega building construction projects in Bahrain, the current implementation process should be assessed and critical factors should be identified.

The approach used to assess TQM implementation relies on inspecting the organizational performance of contractors in Bahrain, in terms of customer satisfaction, employee satisfaction, overall competitive position, and production improvement. In addition, implementation of TQM success factors should be measured along with the Barriers of TQM implementation process. Figure 3.3 summarizes the problem solving process that followed.

To assess the implementation of TQM in the Mega building construction projects in Bahrain, contractors from high grades were selected. Ministry of industry and commerce, ministry of housing and ministry of works, municipalities affairs, and urban planning (MOW), are the associated authorities to communicate with, and gather the data related to the construction contractors in Bahrain.

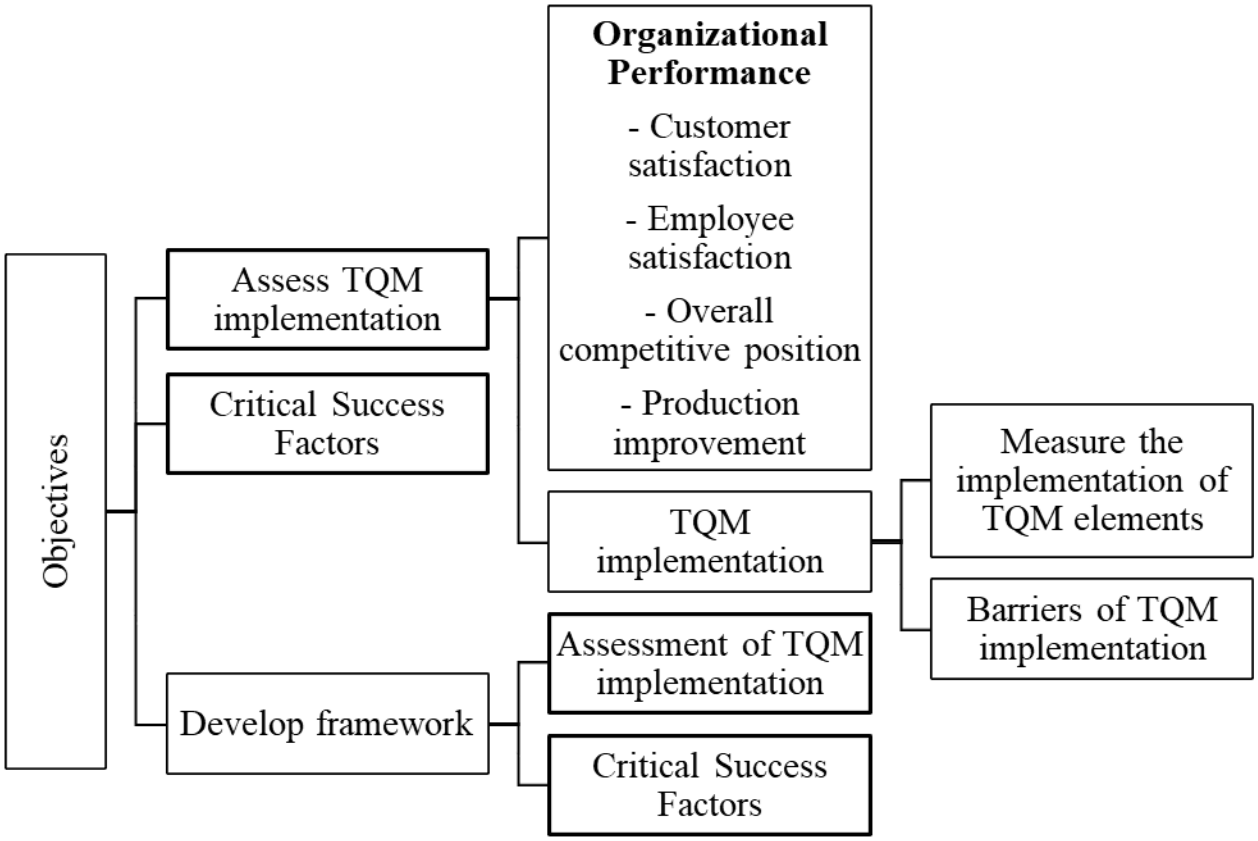


Figure 3.3
The problem solving process

A comprehensive contractors list from ministry of works, municipalities affairs, and urban planning were obtained for data collection. As per the list of contractors, the total number of the prequalified contractors of building construction projects registered in MOW at year 2019 practicing their work in Bahrain is 236, classified to grades AA, A, B, C, D, E, and F based on the budget of the projects they build. Two grades of building construction contractors were selected to represent the Mega building construction contractors in Bahrain (further explanation in section 4.4.1 Population). Figure 3.4 summarize the data collection process.

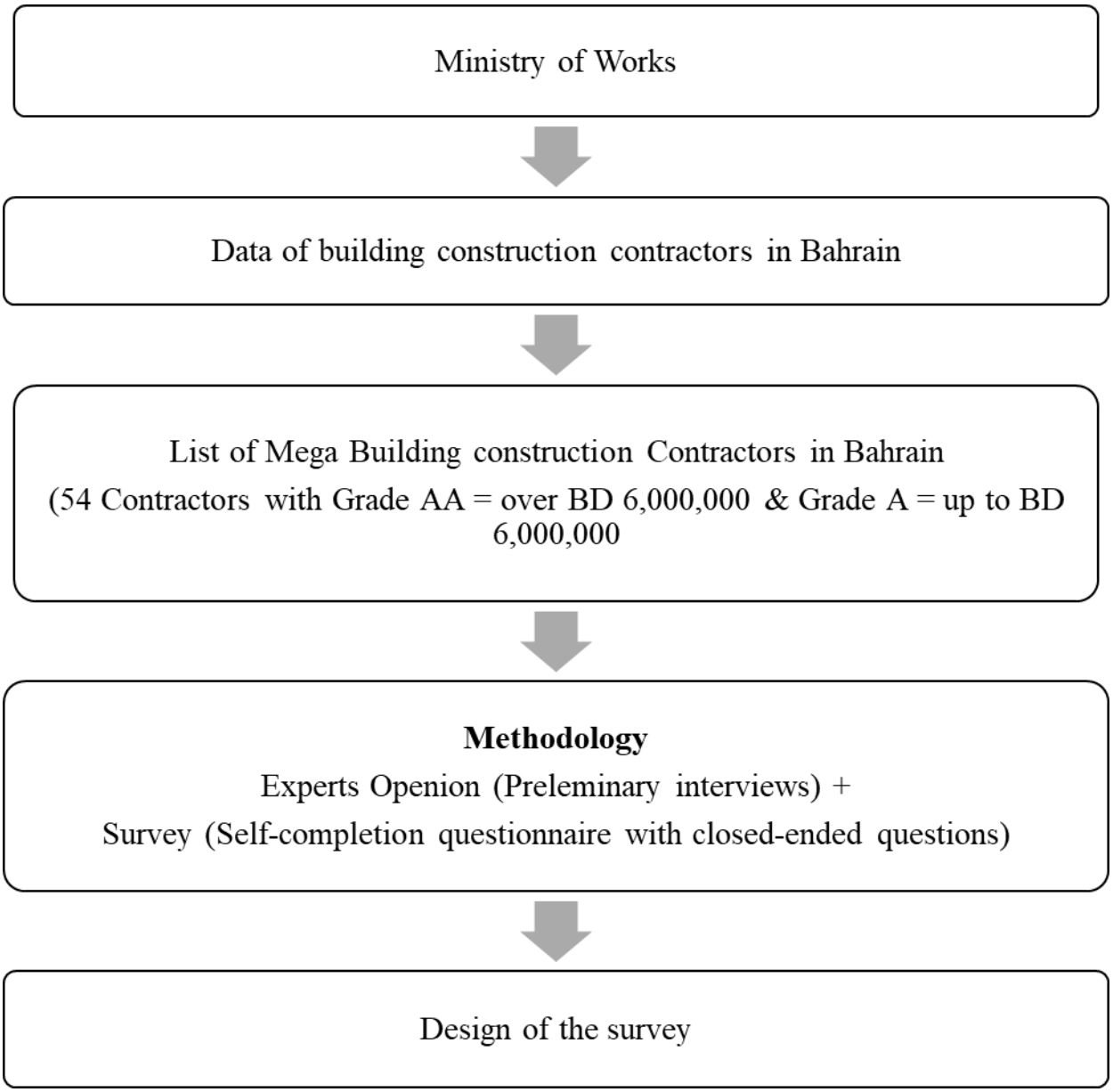


Figure 3.4
Data collection process

3.3.2 Research Tools

Data collection process entails several effective research resources and tools to get valuable, fact-based, accurate, and reliable data required for understanding and analyzing the implementation processes.

In this part, a brief description of the tools introduced initially on this chapter (section 3.2.4) and the selected tools to use in this study are listed below.

3.3.2.1 Literature review

The preliminary data for this research was collected from the review of the literature for the selected topic by searching articles in academic journals that have studied the two variables; success factors and TQM implementation.

The success factors of TQM implementation are the factors that should be focused in and improved, to achieve successful implementation of TQM and get the desired results. Thus, the critical success factors were derived from the main factors. The **Success Factors** of TQM Implementation used in the questionnaire design based on previous studies were presented on table 2.1 (section 2.5 - literature summary). In addition, barriers of TQM implementation were collected and summarized as presented in table 3.2.

Table 3.2

Potential Barriers of TQM Implementation used in the developed questionnaire based on previous studies

Potential Barriers of TQM Implementation
Lack of top-management commitment
Lack or insufficient education and training
Perception of costly and time consuming of TQM application
Heavy documentation needed
Low bid subcontractors selection (low bid mindset)
Lack of financial and/or human resources
Lack of employees' involvement
Lack of communication between top managers and employees
Challenges in changing organizational culture
Lack of long-term sustainability

3.3.2.2 Interviews with experts

In addition to the data collected from the literature review, expert's opinion constituted another source, to elicit data from experienced engineers and quality specialists who practiced TQM in reality. Thus, face-to-face/phone interviews were conducted, as an initial tool to collect the preliminary data that were used as

foundation for the next stage. The questions were focused on: TQM success factors, successful implementation of TQM and barriers of TQM implementation.

Thus, 13 engineers and quality experts from Mega construction companies in Bahrain were interviewed and they all agreed on the importance of the pre-defined factors that were collected from the literature review, and they added more factors based on their expertise and point of views. The result of these interviews were the additional factors listed below (table 3.3 and 3.4).

Table 3.3
Additional success factors of TQM Implementation used in the developed questionnaire revealed from interviews with experts

Additional success factors of TQM implementation (Experts opinions)
Time management
Build long-term relationships With clients
Employees empowerment
Innovation strategy
Quality to be assessed at recruitment stage for skilled labours
Sharing lessons learned to understand how to evaluate quality processes for improvement
Understanding of client's requirements and expectations of the project outcome
Planning realistically for time, budget, material and human resources

Table 3.4

Additional Barriers of TQM Implementation revealed from interviews with experts

Additional Barriers of TQM implementation (Experts opinion)
Incompatibility of standardized quality management system with the construction industry
Need for conducting continuous training programs for employee
Frequent design changes
Poor design capacity
Incompetence of project team
Financial difficulties of owner
Government policies and regulations
Lack of experience in complex projects
Improper planning and scheduling
Lack of knowledge and ability in managing construction projects
Corruption and bribery in construction projects
The delays in payment
Economic volatility
Lack of a systematic approach to manage the project
Poor performance of contractors/ sub-contractors
Lack of integration between TQM and existing systems
Lack of integration of internal and external customer-supplier chains

3.3.2.3 Questionnaires

The information gained from the literature review and from the experts' interviews were merged to formulate the items of the comprehensive questionnaire deployed in this research.

3.4 Questionnaire Design and Development

3.4.1 Unit of Analysis

The respondents who participated in this study are:

1. Managerial staff level (manager of department related to construction and/or quality):

- CEO/General Manager/Director
- Project Manager
- Quality Assurance/Control Manager
- Site Manager
- Engineering Department Manager

2. Operational staff level:

- Engineer
- Technician
- Site inspector
- Quality officer

3.4.2 Questionnaire design

A preliminary idea about the type of information needed to be collected in the questionnaire is already determined in the literature review and experts 'interviews. Additional information was extracted from questionnaires in previous literature studies to formulate the sections of the questionnaire as follow:

Section 1- General information.
Section 2- Success Factors of TQM implementation
Section 3- Critical Success Factors of TQM implementation
Section 4- TQM Implementation (Organizational Performance)
Section 5- Barriers of TQM Implementation

Table 3.5 illustrates the scale items used in developing the questionnaire.

Table 3.5
Scale Items used in the questionnaire construct

Variable	Dimension	Total No. of items	Source
Success Factors of TQM implementation	Leadership	8	**(**Bakar, Ali and Onyeizu, 2011; Koh and Low, 2010; Hoonakker, Carayon and Loushine, 2010; Al-Musleh, 2010; Shoshan, 2016)
	Policy and Strategy	4	
	Continuous improvement	6	
	Measurement and Feedback	5	
	Subcontractors and suppliers quality management	5	
	Processes Management	4	
	Resources Management	4	
	Education and training	4	
	Work environment and culture	2	

TQM Implementation (Organizational Performance)		17	(Hoonakker, Carayon and Loushine, 2010; Shoshan, 2016; Yusuf, Gunasekaran and Dan, 2007)
Barriers to TQM Implementation		27	**(**Hoonakker, Carayon and Loushine, 2010; Shoshan, 2016)

To achieve the objectives of the study, two sets of self-completion questionnaires were developed:

- **Type 1 questionnaire** targeted to the Managerial level to extract the information related to the top management practice, and reveal their point of views and the effect of TQM success factors on TQM implementation/organizational performance (Appendix A).
- **Type 2 questionnaire** targeted the Operational level to extract the information related to the operational employees and workforce practice and reveal their point of views and the effect of TQM success factors on TQM implementation/organizational performance (Appendix B).

3.4.3 Questionnaire type 1

Managerial level questionnaire divided into 6 sections:

Section 1: General information

This part comprises five questions pertinent to respondent's education background, career information and position in the firm.

Section 2: Managerial Insights on Adopted Practices

This section comprises six multiple-choice questions pertinent to the top management insights on adopted practices relevant with quality concepts in their firm.

Section 3: Success Factors of TQM implementation

In this part, 32 items were used to assess the success factors that can predict TQM implementation in the surveyed firms. This section comprises six dimensions namely; leadership, policy and strategy, continuous improvement, measurement and feedback, subcontractors and suppliers' quality management, and processes management. Five points Likert scale for measuring importance was used.

Section 4: Critical Success Factors of TQM implementation

This section is relevant with the identification of the Critical Success Factors of TQM implementation. The pre-identified factors were listed, and respondent were asked to rate the factors in order of importance. Five points Likert scale was used to measure this construct ranging from strongly disagree (the weakest rate) to strongly agree (the highest rate).

Section 5: TQM implementation

This section is related to the determination of the TQM implementation. It is designed to offer insights into how issues have changed over the TQM implementation. In another word, the extent to which the firm performance has changed as a result of implementing TQM. Five points Likert scale was used to measure this construct ranging from strongly disagree (the weakest rate) to strongly agree (the highest rate).

Section 6: Barriers of TQM implementation

This section is pertinent with the identification of the potential barriers that hinder the TQM implementation process. The pre-identified Barriers from were listed, and respondents were requested to rate the obstacles that might obstruct TQM implementation in terms of importance. Therefore, five points Likert scale for importance was used.

3.4.4 Questionnaire type 2:

Operational level questionnaire divided into 6 sections:

Section 1: General information

This part contains five questions pertained to respondent's education background, career information and position in the firm.

Section 2: Understanding and practice of quality

This part encompasses four multiple-choice questions related to employee's understanding and practice of quality in their firm.

Section 3: Success factors of TQM

In this part, 38 items were used to assess the success factors that can predict TQM implementation in the surveyed firms. This section comprises of eight dimensions: leadership, continuous improvement, measurement and feedback, subcontractors and suppliers' quality management, processes management, resources management, education and training, and work environment and culture. Five points Likert scale

was used to measure this construct ranging from strongly disagree (the weakest rate) to strongly agree (the highest rate).

Section 4: Critical Success Factors of TQM implementation

This section is relevant with the identification of the Critical Success Factors of TQM implementation. The pre-identified factors were listed, and respondent were asked to rate the factors in order of importance. Five points Likert scale was used to measure this construct ranging from strongly disagree (the weakest rate) to strongly agree (the highest rate).

Section 5: TQM implementation

This section is related to the determination of the TQM implementation. It is designed to offer insights into how issues have changed over the TQM implementation. In another word, the extent to which the firm performance has changed as a result of implementing TQM. Five points Likert scale was used to measure this construct ranging from strongly disagree (the weakest rate) to strongly agree (the highest rate).

Section 6: Barriers of TQM implementation

This section is pertinent with the identification of the potential barriers that hinder the TQM implementation process. The pre-identified Barriers were listed, and respondents were requested to rate the obstacles that might obstruct TQM implementation in terms of importance. Therefore, five points Likert scale for importance was used.

3.4.5 Data Measurement

3.4.5.1 Likert scale

Likert scale is most the frequently used measurement scale in researches surveys. It is used to measure respondent's attitude and opinion towards a particular question or statement. Likert scaling often uses 5 points; each level on the scale is assigned a numeric value, which usually start at 1 and incremented by one for each level to reach five. Likert scale contributes to ease understanding and analyzing of the results (Krosnick, 2009).

In the third part of the questionnaire (Implementation of TQM elements), the Likert five-point scale was used to investigate the extent of quality practice in the selected firms.

The traditional commonly used "Agreement" scale is: strongly disagree, disagree, neither agree nor disagree (undecided), agree and strongly agree. The 5-point form provides the respondent five choices of agreement levels. The higher number indicates the more positive the respondent point of view towards the statement or item.

The total score of all respondents for a statement or item reflects the general attitude or point of view to the given statement. The interpretation of this scale is shown in the table 3.6.

Table 3.6
Interpretation of Likert's Five-Point scale of Agreement

Scale	Unit weigh	Weighted mean interval	Interpretation
Strongly disagree	1	1.00 to 1.79	Very low level
Disagree	2	1.80 to 2.59	Low level

Neither agree nor disagree	3	2.60 to 3.39	Medium
Agree	4	3.40 to 4.19	High level
Strongly agree	5	4.20 to 5.00	Very high level

The Likert five-point scale in section 3 (Critical success factors of TQM implementation) and section 4 (Barriers of TQM implementation) of the questionnaire is used also to identify the extent of significance of the critical success factors and barriers that affect the success of TQM implementation process.

One of the alternative options of traditional Likert Scale is the Importance scale to identify the importance (significance) of the given factors (Vagias, 2006).

Likert importance scale is: not important at all, slightly important, moderately important, important and extremely important. The interpretation of this scale is shown in the table 3.7.

Table 3.7
Interpretation of Likert's five-point scale of importance

Scale	**Unit weigh**	**Weighted mean interval**	**interpretation**
Not Important	1	1.00 to 1.79	Very low importance
Slightly Important	2	1.80 to 2.59	Low importance
Moderately Important	3	2.60 to 3.39	Medium importance
Important	4	3.40 to 4.19	High importance
Extremely Important	5	4.20 to 5.00	Very high importance

The mean of the data for each factor was calculated using Equation (3-1).

$$\text{Mean} = \frac{n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5}{(n_1 + n_2 + n_3 + n_4 + n_5)} \quad (3\text{-}1)$$

3.4.5.2 The relative importance index (RII) of TQM Implementation

The importance index were computed using the relative importance index (RII) shown in Equation (4-2):

$$\text{RII} = \frac{n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5}{5 * (n_1 + n_2 + n_3 + n_4 + n_5)} \times 100 \quad (3\text{-}2)$$

Where:

n_1 = number of respondents who answered 'Strongly Disagree'

n_2 = number of respondents who answered 'Disagree'

n_3 = number of respondents who answered 'Neither agree nor disagree'

n_4 = number of respondents who answered 'Agree'

n_5 = number of respondents who answered 'Strongly Agree'

The computed RII of the factor in each group were ranked in order to know their extent of importance.

The RII value ranges from 0 to 1, the higher the RII, the more statement or factor becomes important (Gündüz et al., 2013). Calculating the average RIIs of the factors in each group gives the RIIs of the mean groups.

3.5 Questionnaire Distribution

The questionnaires were distributed to the respondents through the following channels:

1. In-person interviews
2. Using a web link created by surveymonkey.com online website and share the direct link through email and over what's up.

3.5.1 Population

To assess the implementation of TQM in the Mega building construction projects in Bahrain, and to identify the critical success factors and barriers of this implementation, the building construction contractors from certain grades constituted the population of this study.

According to the Ministry of Works, municipalities affairs and urban planning in Bahrain, there is 236 prequalified contractors of building construction projects registered in MOW (2019) practicing their work in Bahrain, classified to grades AA, A, B, C, D, E, and F based on the budget of the projects they build.

Two grades of building construction contractors were selected to represent the Mega building construction contractors in Bahrain. The below table 3.7 explain the selection criteria.

Table 3.7
Size of enterprise based on size of the project

Grade of Building contractors	Budget of the project	Number of contractors
Grade AA	Over BD 6,000,000/-	54
Grade A	Up to BD 6,000,000/-	26
Total number of participant contractors		80

*The list of building contractors registered with ministry of works is available in appendix C.

3.5.2 Sample Size Determination

In determining sample size, the criteria that should be fulfilled in additional to the population size, like confidence level, sample proportion, and margin of errors.

To determine the sample size out of the population of 80 building contractors, Online sample size Calculator was used. The calculator computes the minimum number of necessary samples to meet the desired statistical constraints.
The result shows that 67 or more measurements/surveys are needed to have a confidence level of 95% that the real value is within ±5% of the measured/surveyed value.

In conclusion, the sample size for 80 building construction contractors classified as AA and A classes with 95% confidence level is 67 contractors.

3.6 Chapter Summary

This chapter explain the research methodology as it encompasses the research approach used which is the **Mixed method** that incorporate both *quantitive and qualitative data*, the purpose of the research selected which is the **Descriptive** research approach that focuses on facts within a selected population. The research type is consider as an **Action research**, the research tools used on this research, which are **interviews and questionnaires**, and finally illustrate the research plan.

This chapter also explain the employment of research methodology tools in order to collect the required data. The approach used for data collection based on collecting data from number of mega building construction contractors in Bahrain. The data collected from the literature review, along with the data collected from interviewing experts on the field, jointly used to formulate two sets of comprehensive questionnaires targeting Managerial and operational levels of the contractor's staff.

Success factors of TQM implementation, organizational performance and barriers to TQM implementation are the variable used on the questionnaire.

The questionnaire distributed to 67 contractors representing the sample size of the total population, which is 80 building contractors in Bahrain from grade AA and grade A.

CHAPTER 4
Results and Analysis of Collected Data

4.1 Introduction

4.2 Distribution of Sample

4.3 Validity and Reliability of the Questionnaire

4.4 Results of the Collected Data

4.5 Correlation Analysis

4.6 Regression Analysis

4.7 Differences according to firms that adopt Quality System and firms that adopt TQM

4.8 Research Findings

4.9 Discussion of Results

4.10 Recommendations

4.11 4.11 Chapter Summary

CHAPTER 4
Results and Analysis of Collected Data

4.1 Introduction

This chapter presents the results, analysis and findings of the data collected through the distributed questionnaires. The raw data collected were analyzed using Statistical Package for Social Science (SPSS) software version 23.

Various statistical tools were used to analyze the data obtained from questionnaire. Initially descriptive statistical tools used such as Mean, Standard deviation (STD), percentage, and Frequencies. In addition to Pearson's Correlation Coefficient, to measure the strength of linear association between two variables, and Analysis of Variance (ANOVA) was used to compare group means (Sedgwick, 2012) (Park, 2009).

4.2 Distribution of the sample

This part of the study highlights the demographic characteristics of the respondents such as qualification (educational level), overall experience in the construction industry, training courses attended, and profession, and position in the firm.

The study sample consisted of 70 respondents (21 managers and 49 employees), from both Managerial and Operational levels, working in the Mega buildings construction projects in Bahrain. The sections 4.2.1 to 4.2.4 present the distribution results of the sample, according to the variables of the study.

4.2.1 Distribution of the sample according to *Educational Level*

Figure 4.1 illustrate the educational level of respondents. As shown, 52 respondents hold Bachelor's degree representing 74.3% of the whole sample, and 12 respondents hold Master's degree representing 17.1% of 70 respondents. Whereas 6 respondents hold Diploma's degree with a percentage of 38.2%.

This might be justified that these construction firms are more inclined to recruit those who have a specific educational background.

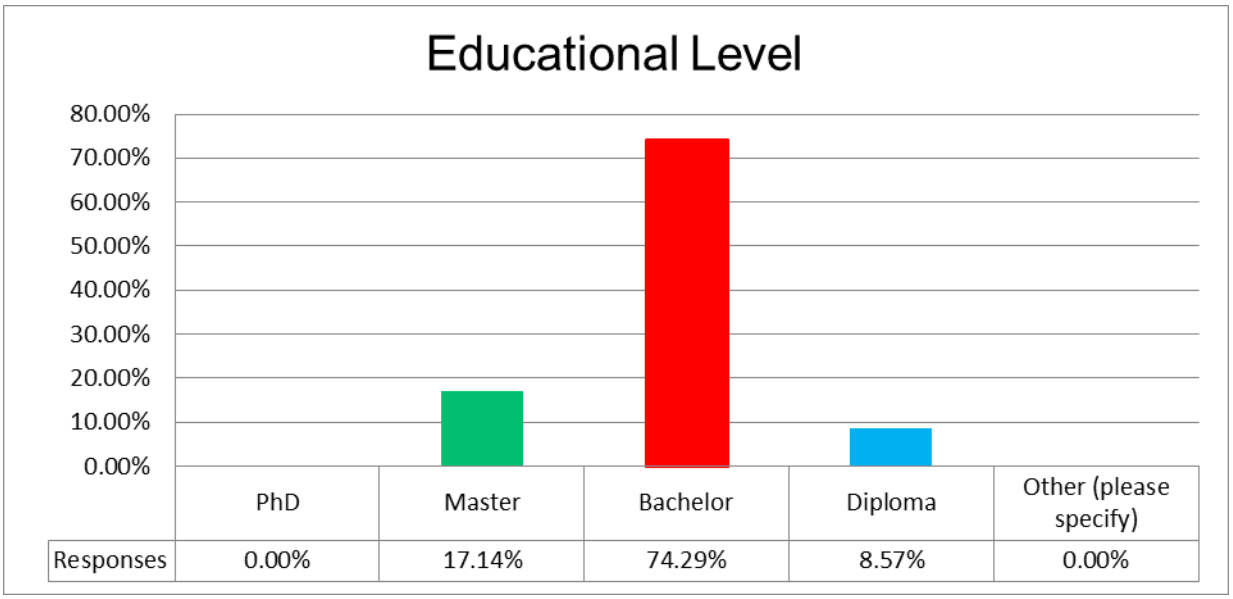


Figure 4.1 Distribution of the sample according to qualification

4.2.2 Distribution of the sample according to *Years of Experience in the construction industry*

In terms of the respondents' years of experience in the construction industry, figure 4.2 shows that respondents possessed work experience of more than 10 years, and those who had work experience of 5 to 10 years are equal, constituting 42.9%.

While, 14.2% of the sample possessed an experience of less than 5 years. This can be justified that these firms' strategy is more inclined to employees' retention.

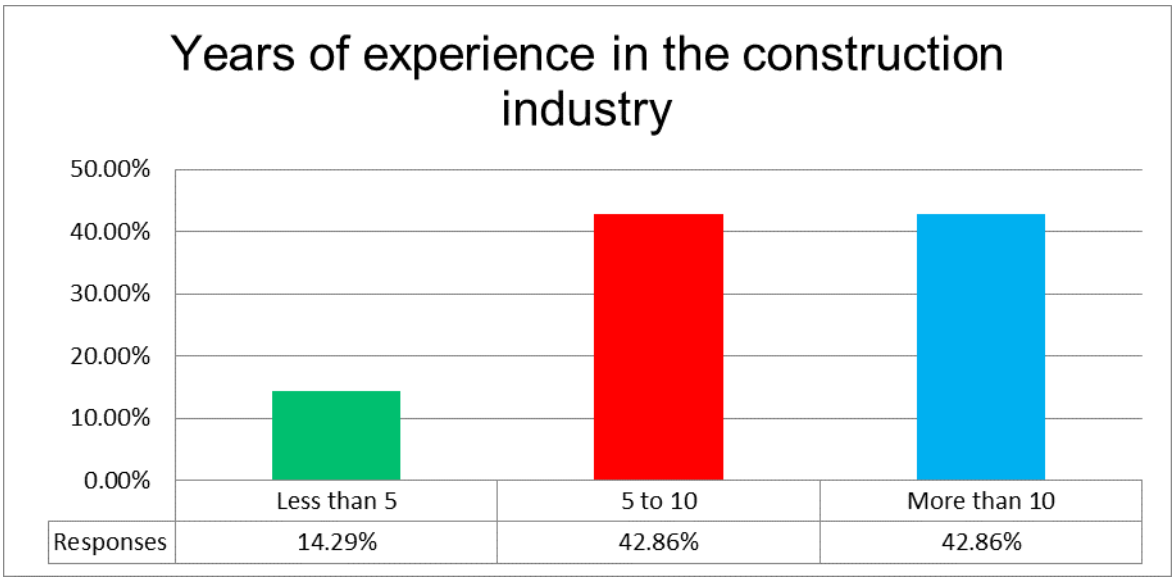


Figure 4.2 Distribution of the sample according to years of experience

4.2.3 Distribution of the sample according to *Number of enrolled training courses related to quality in the surveyed construction firms*

The results in figure 4.3 shows that 25 respondents attended more than three training courses related to quality representing 35.8%. Five respondents attended three training courses related to quality in the construction industry, representing 7.1%. Whereas, 14 respondents attended two training courses related to quality in construction with percentage of 20%, and the same percentage of 20% of the study sample have attended one training course related to quality in construction. The results also show that 12 respondents did not attend any training courses related to quality in construction, representing 17.1% of the whole sample. This reflects the increased awareness of the construction firms in Bahrain to enroll their employees in

training courses, to enable them acquiring the necessary knowledge and skills that are indispensable to practicing quality.

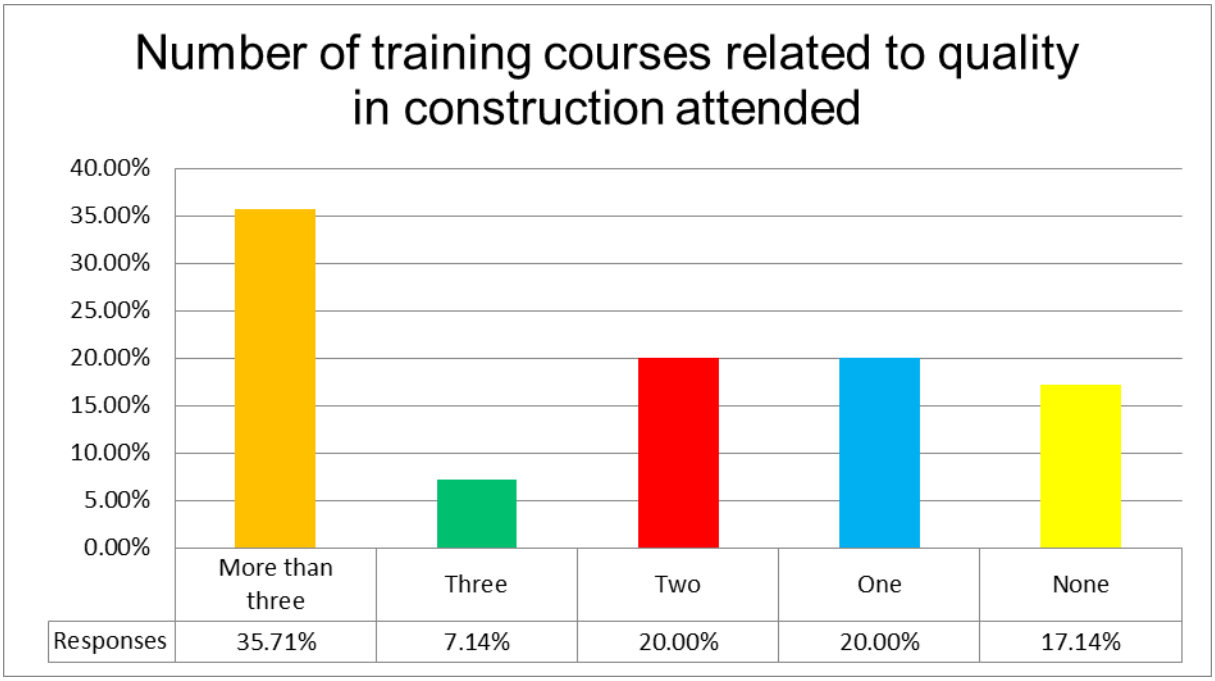


Figure 4.3 Distribution of the Sample According to Number of training courses related to quality in construction

4.2.4 Distribution of the sample according to *Job Level*

The results in figure 4.4 illustrated that 30 % of the respondents belongs to the managerial level (manager of a department related to construction and/or quality). However, 70% of respondents are from operational level (engineers, technician, site inspector or quality officer). This can be justified that the majority of the manpower in any firm is constituted from the operational level (engineers, technician, site inspector or quality officer).

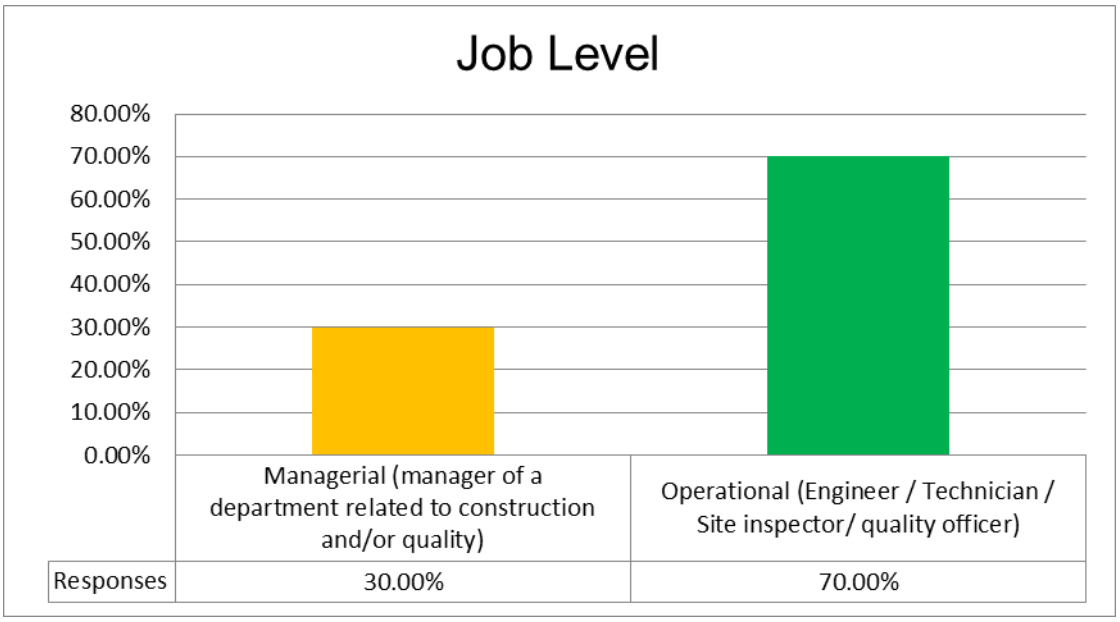


Figure 4.4 Distribution of the Sample According to Job level

4.3 Validity and Reliability of the Questionnaires

Testing the validity and reliability of the questionnaires are indispensable to be tested, in order to assure that the construct items are measuring what they are designed to measure, and to give reliable and similar results in case the questionnaires were distributed in a subsequent time point.

4.3.1 Validity

Validity is defined as the extent to which a concept is accurately measured in a quantitative study. Statistical conclusion validity involves ensuring the use of adequate sampling procedures, appropriate statistical tests, and reliable measurement procedures. To achieve this Construct validity was verified.

“Construct validity is the extent to which the measure 'behaves' in a way consistent with theoretical hypotheses and represents how well scores on the instrument are indicative of the theoretical construct” (Hays and Reeve, 2017).

To verify the validity of the scale, the Pearson’s Correlation Coefficient between the scale items was calculated. The results are shown in the following tables (4.1 to 4.12).

Table 4.1 show that there is a statistically significant relation between each of the items associated with Leadership success factor and its scale, as the correlation coefficient values range from 0.293 to 0.780. This indicates that the scale is valid to meet the research objectives.

Table 4.1
Validity of the Leadership dimension (n=70 – managerial and operational)

No	Item	Correlations
1	Management build an improvement culture	0.436(**)
2	Employees are involved in the decision- making	0.600(**)
3	Clear mission is developed regarding business objectives	0.780(**)
4	Management act as key driver in continuous improvement	0.293(*)
5	Communication links established between employees and management	0.621(**)
6	Management provide a proper and clear system to increase productivity	0.760(**)
7	Management encourages communication between employees and suppliers/subcontractors	0.570(**)
8	Employees are empowered to make significant changes on their daily activity	0.776(**)

* Significant in (0.05) ** Significant in (0.01) (0.277)

Table 4.2 show that there is a statistically significant relation between each of the items associated with Policy and Strategy success factor and its scale, as the correlation coefficient values range from 0.473 to 0.950. This indicates that the scale is valid to meet the research objectives.

Table 4.2
Validity of the Policy and strategy dimension (n=21 - managerial)

No	Item	Correlations
1	Management provides policies promoting customer satisfaction.	0.712(**)
2	The concept of TQM is reflected in the firm's strategy, vision and mission.	0.531(*)
3	The firm's policy and strategy are managed and reviewed on a regular basis.	0.950(**)
4	Necessary resources are available for achieving the firm's policy and strategy.	0.473(*)

* Significant in (0.05) ** Significant in (0.01) (0.277)

Table 4.3 show that there is a statistically significant relation between each of the items associated with Continuous Improvement success factor and its scale, as the correlation coefficient values range from 0.671 and 0.851. This indicates that the scale is valid to meet the research objectives.

Table 4.3
Validity of the Continuous improvement dimension (n=70 - managerial and operational)

No	Item	Correlations
1	The firm processes are improved regularly	0.671(**)
2	The firm encourages innovation and creativity in process performance improvement	0.830(**)

No	Item	Correlations
3	Improvement teams exist in all functions	0.844(**)
4	The quality improvement teams are effective	0.814(**)
5	All Employees are trained to implement the continuous improvement philosophy in their daily activity	0.851(**)
6	Sufficient training courses on quality improvement tools and techniques are provided	0.823(**)

* Significant in (0.05) ** Significant in (0.01) (0.277)

Table 4.4 show that there is a statistically significant relation between each of the items associated with Measurement and Feedback success factor and its scale, as the correlation coefficient values range from 0.504 to 0.785. This indicates that the scale is valid to meet the research objectives.

Table 4.4
Validity of the Measurement and feedback dimension (n=70 - managerial and operational)

No	Item	Correlations
1	Customer feedback is measured by customer surveys, focus groups, compliments and/or complaints	0.508(**)
2	Data collection system monitors and predicts the improvement process	0.639(**)
3	Employee's opinion and suggestions system is exist and considered in the improvement procedure	0.785(**)
4	The main goal of performance measurement in the firm is to ensure customer requirements have been met	0.536(**)
5	The firm provides employees performance appraisal	0.504(**)

* Significant in (0.05) ** Significant in (0.01) (0.277)

Table 4.5 show that there is a statistically significant relation between each of the items associated with Subcontractors and Suppliers Quality Management success factor and its scale, as the correlation coefficient values range from 0.433 to 0.769. This indicates that the scale is valid to meet the research objectives.

Table 4.5
Validity of the Subcontractors and suppliers' quality management dimension (n=70 - managerial and operational)

No	Item	Correlations
1	Subcontractors/suppliers are involved in processes improvement	0.467(**)
2	Subcontractors/suppliers audit and evaluation are important activities to be conducted	0.686(**)
3	Subcontractors/suppliers provide reliable quality data	0.545(**)
4	The firm works with subcontractors/suppliers towards long term partnerships	0.433(**)
5	Quality aspects is the basis of Subcontractors/suppliers selection.	0.769(**)

* Significant in (0.05) ** Significant in (0.01) (0.277)

Table 4.6 show that there is a statistically significant relation between each of the items associated with Process Management success factor and its scale, as the correlation coefficient values range from 0.658 to 0.726. This indicates that the scale is valid to meet the research objectives.

Table 4.6
Validity of the Processes management dimension (n=70 - managerial and operational)

No	Item	Correlations
1	Critical processes are identified	0.669(**)

No	Item	Correlations
2	Critical processes are improved	0.658(**)
3	Critical processes are monitored	0.726(**)
4	Critical processes are designed and developed based on customer needs and expectations	0.675(**)

* Significant in (0.05) ** Significant in (0.01) (0.277)

Table 4.7 show that there is a statistically significant relation between each of the items associated with Resources Management success factor and its scale, as the correlation coefficient values range from 0.695 to 0.857. This indicates that scale is valid to meet the research objectives.

Table 4.7
Validity of the Resources Management dimension (n=49 - operational)

No	Item	Correlations
1	Sufficient financial resources are provided to support the improvement activities	0.857(**)
2	Human resources is considered in improvement activities	0.747(**)
3	Technical resources (e.g. software, equipment) are provided	0.804(**)
4	Resources are effectively deployed in the development of firm's activities	0.695(**)

* Significant in (0.05) ** Significant in (0.01) (0.277)

Table 4.8 show that there is a statistically significant relation between each of the items associated with Education and Training success factor and its scale, and its scale as the correlation coefficient values range from 0.756 to 0.818. This indicates that scale is valid to meet the research objectives.

Table 4.8
Validity of the Education and training dimension (n=49 – operational)

No	Item	Correlations
1	Continuous learning is provided through education and training courses	0.776(**)
2	Employees are trained for the needed job skills set	0.818(**)
3	Employees are trained on TQM concepts	0.756(**)
4	Sufficient training time is provided for employees	0.806(**)

* Significant in (0.05) ** Significant in (0.01) (0.277)

Table 4.9 show that there is a statistically significant relation between each of the items associated with Work Environment success factor and its scale, as the correlation coefficient values range from 0.554 to 0.885. This indicates that scale is valid to meet the research objectives.

Table 4.9
Validity of the Work environment and culture dimension (n=49 - operational)

No	Item	Correlations
1	Employees have good compliance to the quality culture change	0.554(**)
2	The current statues motivates employees to contribute towards building a quality culture	0.885(**)

* Significant in (0.05) ** Significant in (0.01) (0.277)

Table 4.10 show that there is a statistically significant relation between each of the items associated with the Critical Success Factors and its scale, as the correlation coefficient values range from 0.245 to 0.572. This indicates that scale is valid to meet the research objectives.

Table 4.10
Validity of the Critical Success Factors of TQM implementation dimension (n=70 – managerial and operational)

No	Item	Correlations
1	Top management's commitment and leadership	0.408(**)
2	Organizational culture	0.455(**)
3	Quality education and training	0.426(**)
4	Communication between top managers and employees	0.426(**)
5	Subcontractors and suppliers assessment procedures	0.403(**)
6	Long-term relationships with subcontractors and suppliers	0.518(**)
7	Teamwork	0.393(**)
8	Measuring customer satisfaction periodically	0.371(**)
9	Employees' involvement	0.478(**)
10	Employees' satisfaction	0.366(**)
11	Business environment	0.367(**)
12	Time management	0.435(**)
13	Build long-term relationships With clients	0.665(**)
14	Continuous improvement	0.572(**)
15	Employees empowerment	0.379(**)
16	Company's quality policy	0.464(**)
17	Process management	0.417(**)
18	Availability of comprehensive quality information	0.438(**)
19	Innovation strategy	0.439(**)
20	Quality to be assessed at recruitment stage for skilled labors.	0.245(*)
21	Sharing lessons learned to understand how to evaluate quality processes for improvement	0.366(**)
22	Understanding of client's requirements and expectations of the project outcome	0.420(**)
23	Planning realistically for time, budget, material and human resources	0.471(**)

* Significant in (0.05) ** Significant in (0.01) (0.277)

Table 4.11 show that there is a statistically significant relation between each of the items associated with Organizational Performance and its scale, as the correlation coefficient values range from 0.383 to 0.691. This indicates that scale is valid to meet the research objectives.

Table 4.11
Validity of TQM implementation (Organizational Performance) dimension (n=70 – managerial and operational)

No	Item	Correlations
1	The productivity has improved	0.513(**)
2	Timely completion of the project	0.581(**)
3	Customer satisfaction has increased	0.571(**)
4	Employees performance has improved	0.588(**)
5	The profit has increased (Profit maximization)	0.463(**)
6	Employees job satisfaction and motivation has increased	0.383(**)
7	Positive change in employees skills, knowledge and abilities	0.476(**)
8	The competitive position of your company has strengthened	0.529(**)
9	The waste has reduced	0.604(**)
10	Improved and innovative processes cause efficiency improvement	0.610(**)
11	Production deficiencies reduction	0.636(**)
12	The firm's overall market share has increased	0.691(**)
13	The occupational accidents minimized	0.604(**)
14	Increased client loyalty and retention and reduced customer complaints	0.425(**)
15	Change order has reduced	0.582(**)
16	Adaptability to changing or emerging market conditions and government regulations	0.468(**)
17	Employee turnover has decreased	0.392(**)

* Significant in (0.05) ** Significant in (0.01) (0.277)

Table 4.12 show that there is a statistically significant relation between each of the items associated with Barriers of TQM Implementation and its scale, as the correlation coefficient values range from 0.275 to 0.581. This indicates that scale is valid to meet the research objectives.

Table 4.12
Validity of the Barriers of TQM implementation dimension (n=70 – managerial and operational)

No	Item	Correlations
1	Lack of top-management commitment	0.314(**)
2	Lack or insufficient education and training	0.430(**)
3	Perception of costly and time consuming of TQM application	0.387(**)
4	Heavy documentation needed	0.278(*)
5	Low bid subcontractors selection (low bid mindset)	0.275(*)
6	Lack of financial and/or human resources	0.457(**)
7	Lack of employees' involvement	0.529(**)
8	Lack of communication between top managers and employees	0.454(**)
9	Challenges in changing organizational culture	0.431(**)
10	Lack of long-term sustainability	0.556(**)
11	Incompatibility of standardized quality management system with the construction industry	0.444(**)
12	Need for conducting continuous training programs for employee	0.480(**)
13	frequent design changes	0.479(**)
14	Poor design capacity	0.550(**)
15	Incompetence of project team	0.478(**)
16	Financial difficulties of owner	0.299(*)
17	Government policies and regulations	0.301(*)
18	Lack of experience in complex projects	0.539(**)
19	Improper planning and scheduling	0.507(**)

No	Item	Correlations
20	Lack of knowledge and ability in managing construction projects	0.540(**)
21	Corruption and bribery in construction projects	0.389(**)
22	The delays in payment	0.417(**)
23	Economic volatility	0.323(**)
24	Lack of a systematic approach to manage the project	0.581(**)
25	Poor performance of contractors/ sub-contractors	0.533(**)
26	Lack of integration between TQM and existing systems	0.436(**)
27	lack of integration of internal and external customer-supplier chains	0.445(**)

* Significant in (0.05) ** Significant in (0.01) (0.277)

4.3.2 Reliability of the scale

The reliability model used to assess the internal consistency of all factors through the determination of the Cronbach's alpha coefficient. The reliability criterion (Cronbach alpha) of each of the sections were calculated and the results showed that the correlation coefficient values range from (0.76) and (0.89), which indicate high levels of reliability and indicates that the success factors generated from the literature and the interviews were reliable.

4.4 Results of the collected data

Once the raw data collected from the questionnaires, the responses were analyzed using Statistical Package for Social Science (SPSS) software version 23. Data were analyzed using descriptive statistical tools such as Mean, Standard deviation (SD), percentage and Frequencies.

4.4.1 Managerial insights on adopted practices

This part targeted ***Managerial level*** in the mega building construction firms (managers of departments related to construction and/or quality). It contains six multiple-choice questions related to the top management insights on adopted practices to assess the application of quality concepts into the organizational performance.

4.4.1.1 The highest priority policy of the construction projects at the firm

Figure 4.5 show that the highest priority policy of the construction projects at the studied firms is the "Customer satisfaction" with a percentage of 42.9%. The second-high policy is "Timely completion of the project" with a percentage of 38.1%, followed by "within the budget" with a percentage of 14.3%. The forth policy is "Abide by quality standards" with a percentage of 4.76% only. The result shows also that the policy of "Occupational health and safety" and "Clean environment" is not a priority. This reflects that these firms lack focusing on the occupational health and safety that assure protecting their staff from any occupational health and potential accidents that can threat their overall health and safety. Additionally, there is a lack of clean environment policy that can likely lead to potential environmental pollution due to the lack of such policy.

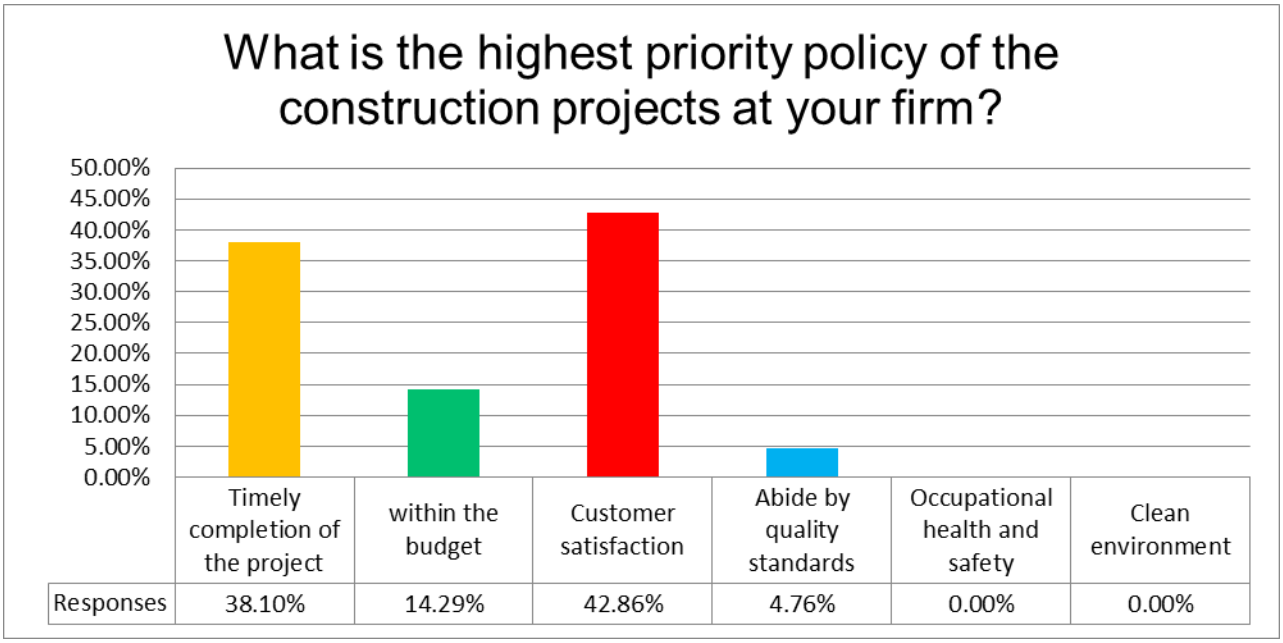


Figure 4.5 Percentage of the highest priority policy of the construction projects at the firm

4.4.1.2 The quality system and/or approach that firms adopt

The results in figure 4.6 show that the quality system that firms mostly adopts is the "ISO standards" with a percentage of 81.0%. The results also show that 52.4% of firms are using "Total Quality Management", followed by "Quality Assurance" with a percentage of 28.6%. Three firms only are using "Six Sigma" as quality improvement approach, with a percentage of 14.3%. This can be justified that all of the quality management systems focuses on achieving good quality, while reducing defects. However, TQM focuses on the development of process to achieve good quality. In TQM, processes are managed and improved to maximize the customer satisfaction with the lowest cost possible. TQM is consider to be a predecessor system or an antecedent to the other quality systems. As well as, another quality system or more can be used along side TQM.

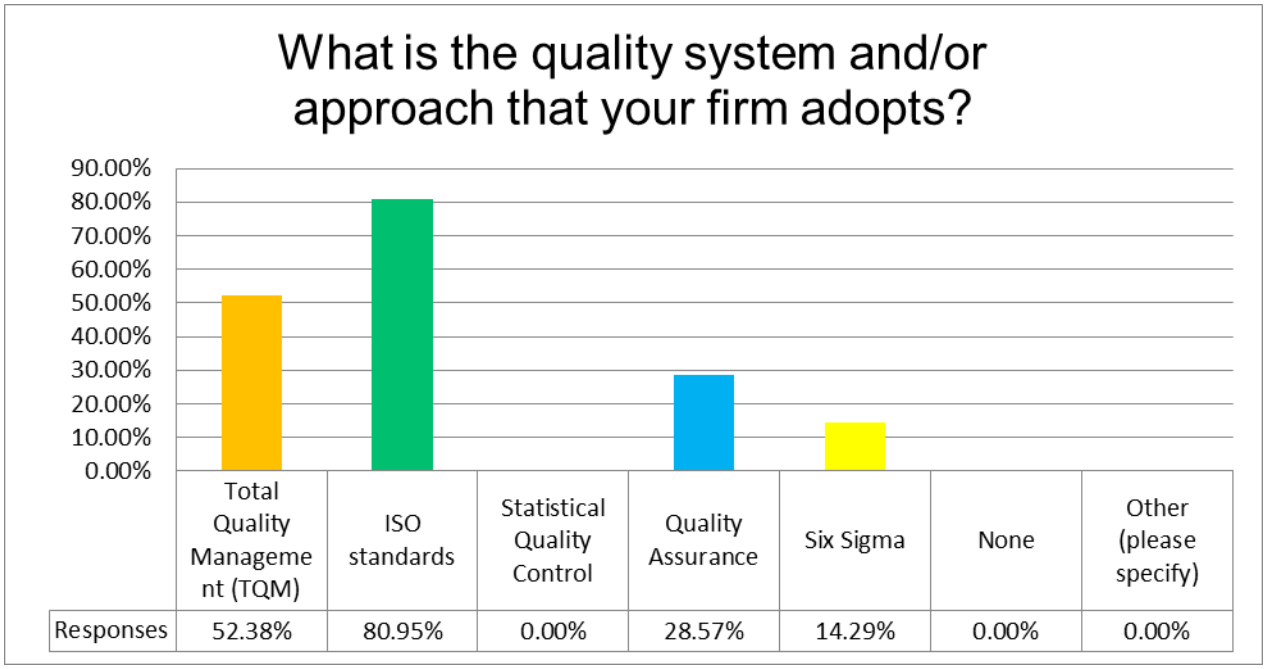


Figure 4.6 Quality system and/or approach that firms adopt

4.4.1.3 Number of times the organization measures customer satisfaction

Figure 4.7 show that seven firms of the sample measures customer satisfaction "Semi-annually" which represent 33.4%. However, five firms of the sample measures customer satisfaction "Annually", which represent 23.8%. Additionally, four firms of the sample measure customer satisfaction "Monthly", which represent 19%, and 9.5% measures customer satisfaction "Quarterly". Whereas, two firms with a percentage of 38.2% "Do Not Measure" customer satisfaction. This highlight that firms should maintain a close contact with the customer to assure meeting their expectations and needs, in order to achieve customer satisfaction. This can only be done by measuring customer satisfaction in systematic way on regular basis along short periods.

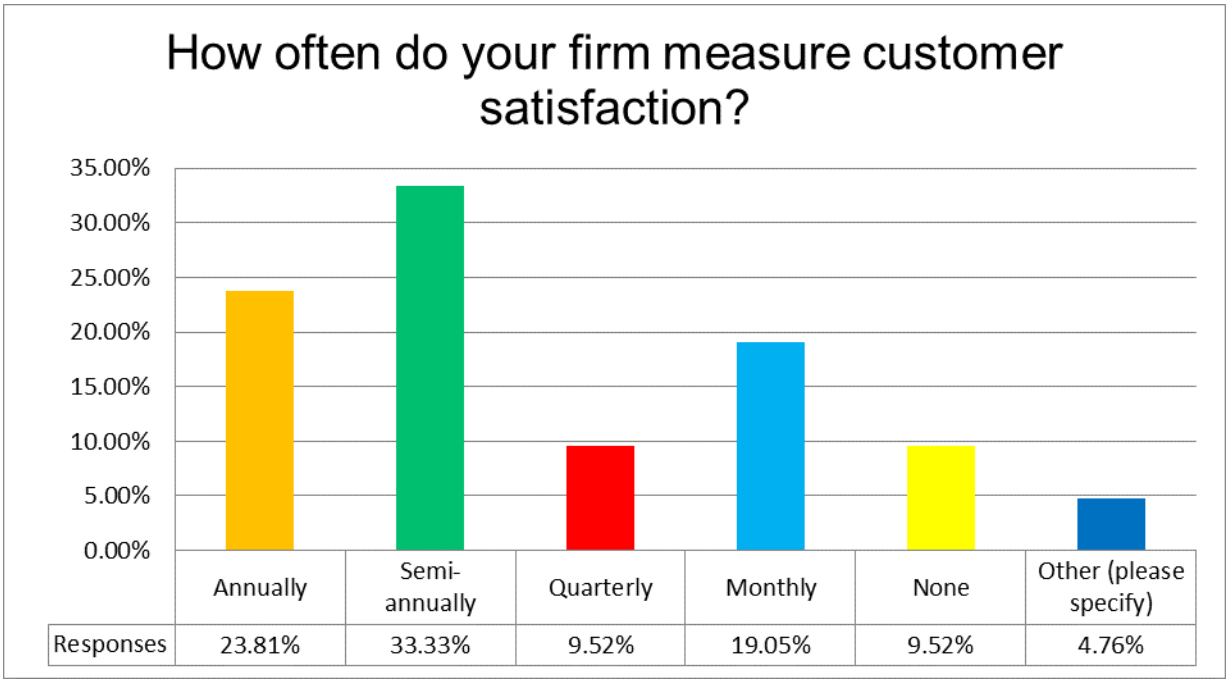


Figure 4.7 Number of times customer satisfaction is measured

4.4.1.4 Organization's purpose of quality

Figure 4.8 show that 13 organizations representing 61.9% are using quality for the purpose of "Elimination of defects", and six organizations of the sample are using quality for the "Competitive advantage" representing 28.6%. Moreover, one firm of the sample their purpose of quality is to "Increase profits ", and another firm is using quality to "Develop business". This asserts that all the investigated firms believe that they should perform with zero defects, through eliminating any potential errors that would impede the quality of their performance.

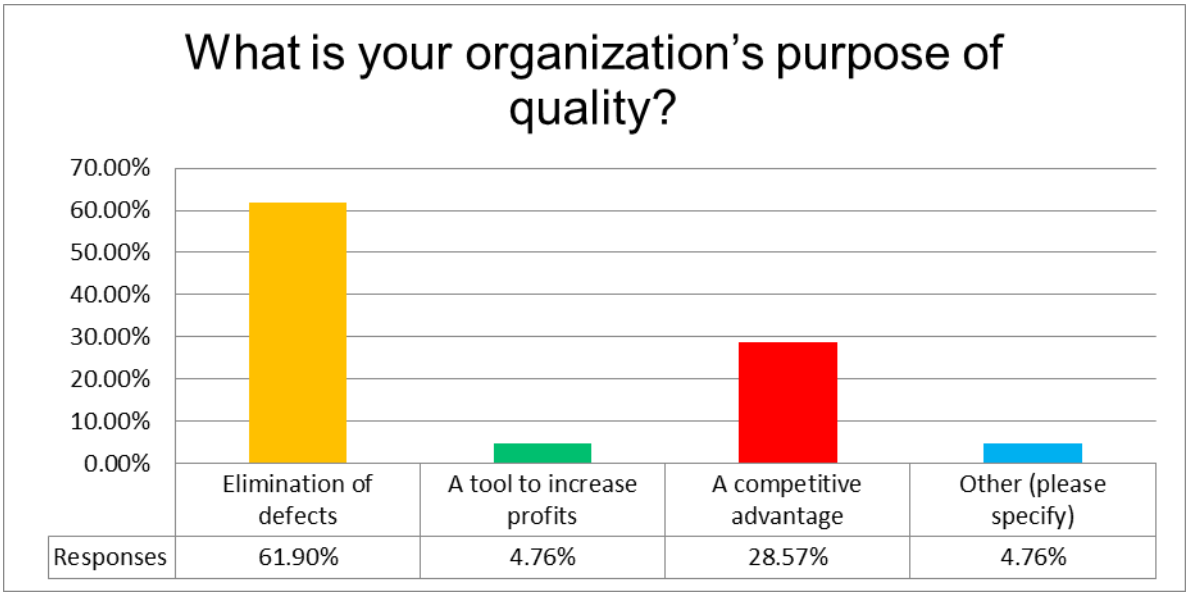


Figure 4.8 Organization's purpose of quality

4.4.1.5 Rating suppliers and subcontractors

Figure 4.9 show that 66.7% of the organizations are "Mostly" rating their suppliers and subcontractors, while 23.8% of the organizations rate suppliers and subcontractors "Sometimes". Two organizations "Never" rate their suppliers and subcontractors. This reflect the tenet of the investigated firms that material' suppliers and subcontractors play vital roles in the quality of the construction projects. Thus, frequent measuring of suppliers and subcontractors' performance is indispensable to assure efficiency, as particularly good quality material selection enhances the overall project quality.

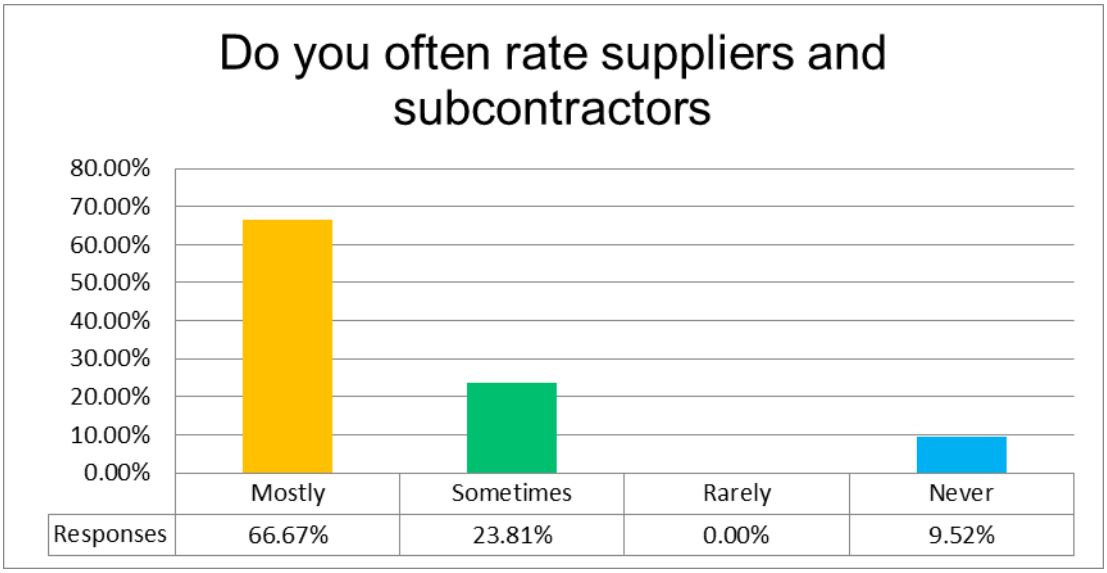


Figure 4.9 Rating suppliers and subcontractors

4.4.1.6 Organization's approach in solving quality related problems

Figure 4.10 show that firms approach in solving quality related problems. Eleven organizations of the sample have "A permanent team is available" to solve quality related problems representing 52.4%, and 8 organizations "Form a multidisciplinary team for each problem" representing 38.1%. The results reveal also that two firm "Assign an individual" to solve quality related problems representing 9.5. This highlight that these firms have realized that in order to able to achieve good quality, it is essential that quality related problems should be tackled and solved once they occur. This urged these firms to either have clear practices to address these problems being through a multidisciplinary team for each problem, or through the availability of a permanent team dedicated to solve quality related problems.

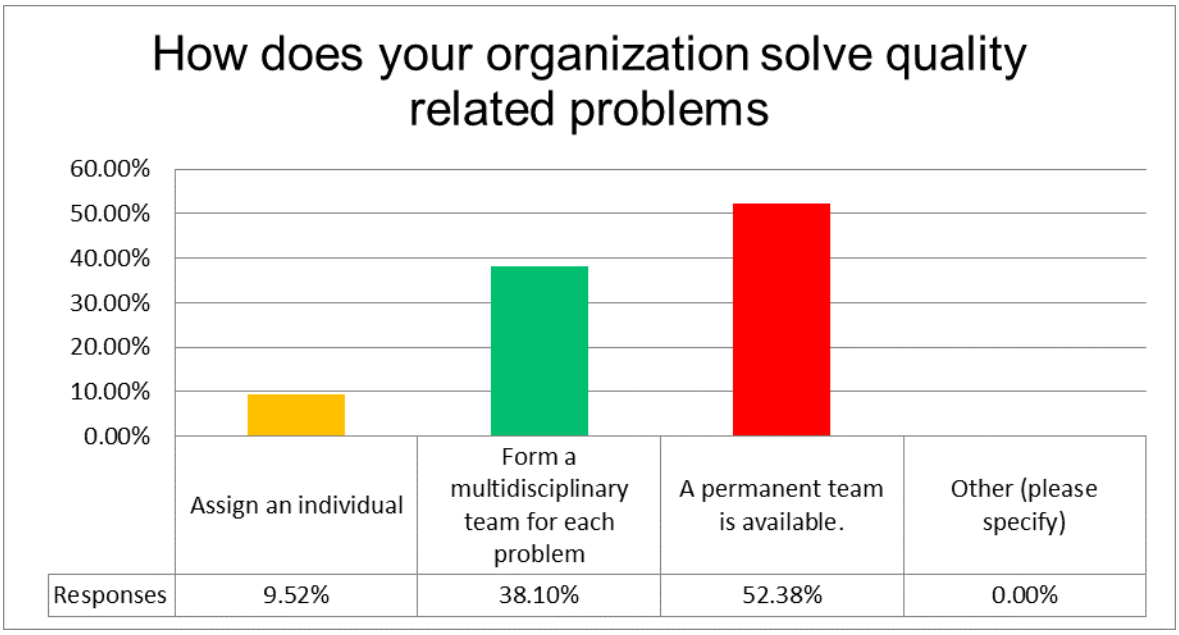


Figure 4.10 Organization's approach in solving quality related problems

4.4.2 Understanding and practice of quality

This section targeted ***Operational level*** in the mega building construction firms (Engineers / Technician / Site inspector / Quality officer). It comprises four multiple-choice questions to examine the employee's perception about quality based on their expertise and the level of understanding and practice of quality in their firms.

4.4.2.1 The best definition of quality from employees' perceptions

Figure 4.11 show that 21 respondents believe that the best definition of quality is to "Meet customer expectations" which represent 42.9%, and 17 respondents believe that the best definition of quality is to "Meet standards and codes" representing 34.7%. Seven respondents believe that the best define of the quality is holding a "Quality certification" with a percentage of 14.3%. Whilst, three respondents believe that the best definition of the quality is to "Meet employee expectations" representing 6.1%. One respondent consider quality as "Teamwork". This reflects

that these firms consider meeting their customers' expectations along with meeting standards and codes provide them with a competitive advantage drawing on perceiving customers' expectations, and standards as the core and corner stone of quality.

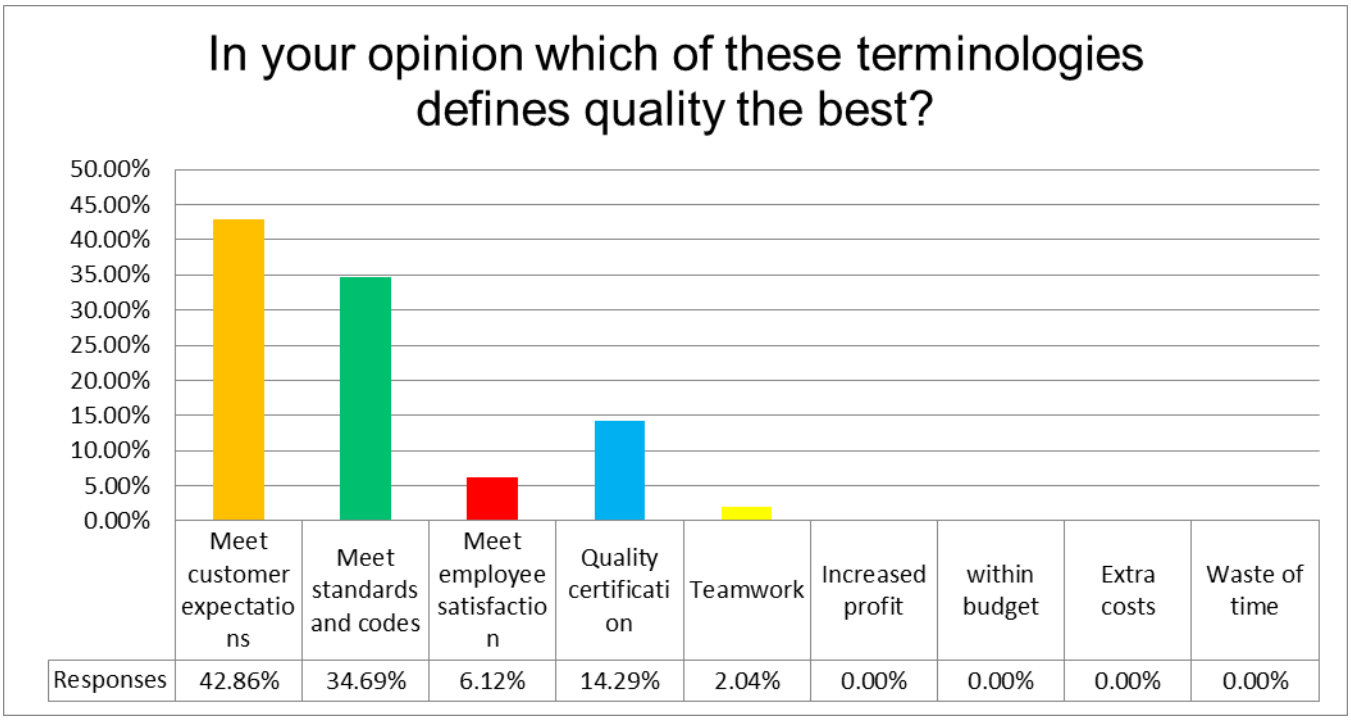


Figure 4.11 The best definition of quality from employees' perceptions

4.4.2.2 The relationship between ISO standards and TQM

Figure 4.12 show that 69.4% believes that the "ISO standards is part of TQM", whereas 20.4% believes that the "ISO standards and TQM are Similar to each other". However, 10.2% of the sample believes that the ISO standards and TQM are "Totally different from each other". This reflects that the surveyed firms have a thorough knowledge that TQM is a broad discipline that encompasses many standards, such as ISO and other standards.

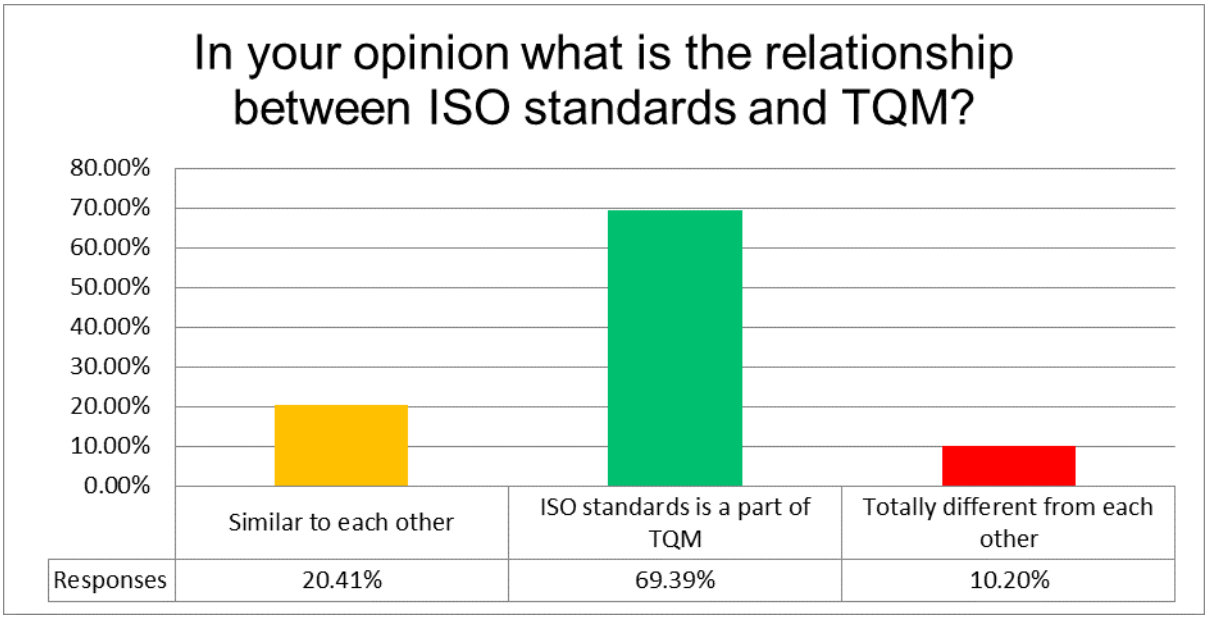


Figure 4.12 The relationship between ISO standards and TQM

4.4.2.3 The highest priority policy of the construction projects at the firm

Figure 4.13 show that 15 respondents stated that the highest priority policy of the construction projects at their firm is "Within budget" representing 30.6%. Another 15 respondents with the same percentage of the sample stated that the highest priority policy of the construction projects at their firm is "Customer satisfaction". In addition, 12 respondents stated that the highest priority policy of the construction projects at their firm is "Timely completion of the project" representing 24.5%. However, five subjects stated that the highest priority policy of the construction projects at their firm is "Abide by quality standards" with a percentage of 14.3%. This justifies that the surveyed firms perceived that completing the project according to the pre- set deadline indicate the commitment of these firms in terms of abiding to this deadline.

Along without exceeding the planned budget that secure their profit margins which contribute highly to fulfilling their customers' needs, which by its turn will cater tremendously to their satisfaction.

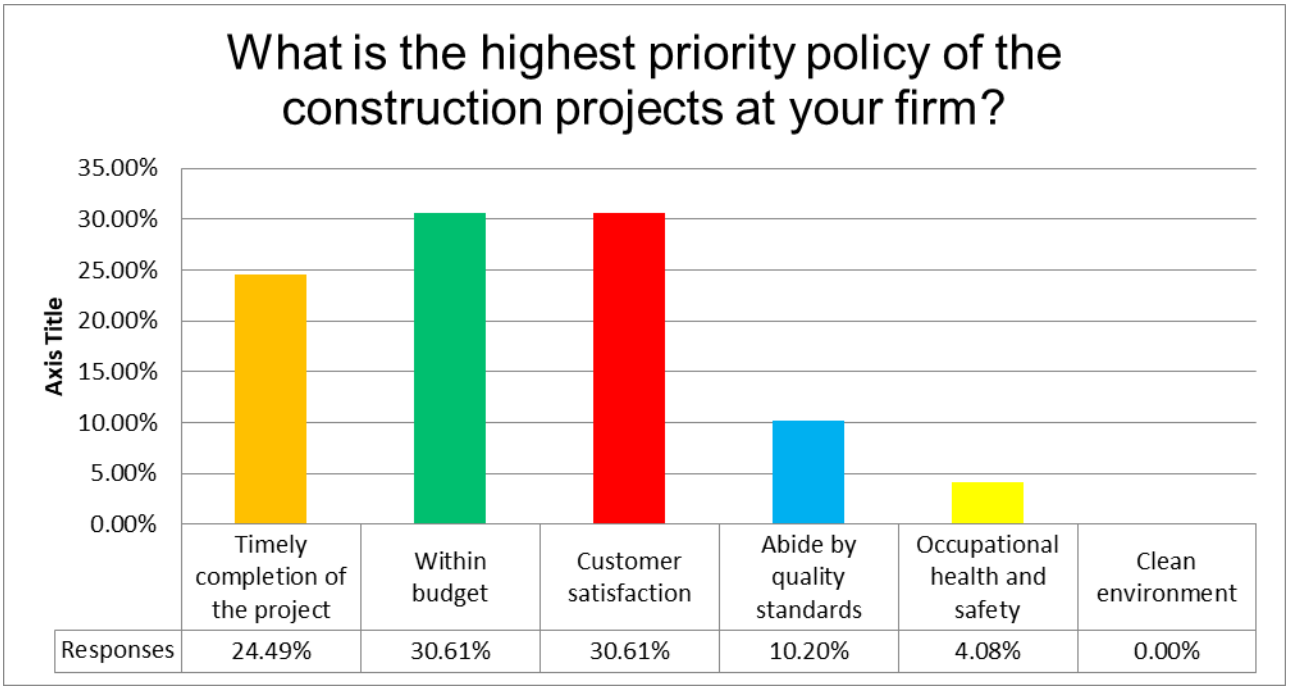


Figure 4.13 The highest priority policy of the construction projects at the firm

4.4.2.4 The quality improvement tools or techniques using by the firm

Table 4.13 and figure 4.14 display that the most implemented quality improvement tool or technique used by 49 of the surveyed firms was "Check sheet" with a percentage of 67.3%. Followed by "Flow chart" with a percentage of 61.2%. in addition, "Plan Do Check Act (PDCA)" with a percentage of 55.1%, "Histogram" with a percentage of 32.7%, "Pareto analysis" and "Cause and effect diagram" with a percentage of 10.2% for each and finally "Quality Function Deployment", "Failure

mode and Effect analysis" and "Statistical control charts" with a percentage of 4.1% for each.

Furthermore, the results show that 11 firms out of the 49 surveyed firms are using only one quality improvement tool or technique representing 22.45%. However, 38 surveyed firms are using more than one quality improvement tool or technique, representing 77.55%. This reflects that many of the surveyed firms confirmed pursuing common quality improvement tools like Check sheet, Flow chart and Plan Do Check Act.

Table 4.13The quality improvement tools or techniques using by the firm (n=49 – operational)

Response	Frequency	Percentage (%)
Plan Do Check Act	27	55.1%
Quality Function Deployment	2	4.1%
Failure mode and Effect analysis	2	4.1%
Pareto analysis	5	10.2%
Histogram	16	32.7%
Cause and effect diagram	5	10.2%
Flow chart	30	61.2%
Scatter diagram	1	2.0%
Check sheet	33	67.3%
Nominal Group Technique	0	0.0%
Statistical control charts	2	4.1%
Why-Why Diagram	0	0.0%

* Check sheet of the adopted quality improvement tool or technique in the surveyed firms in appendix D.

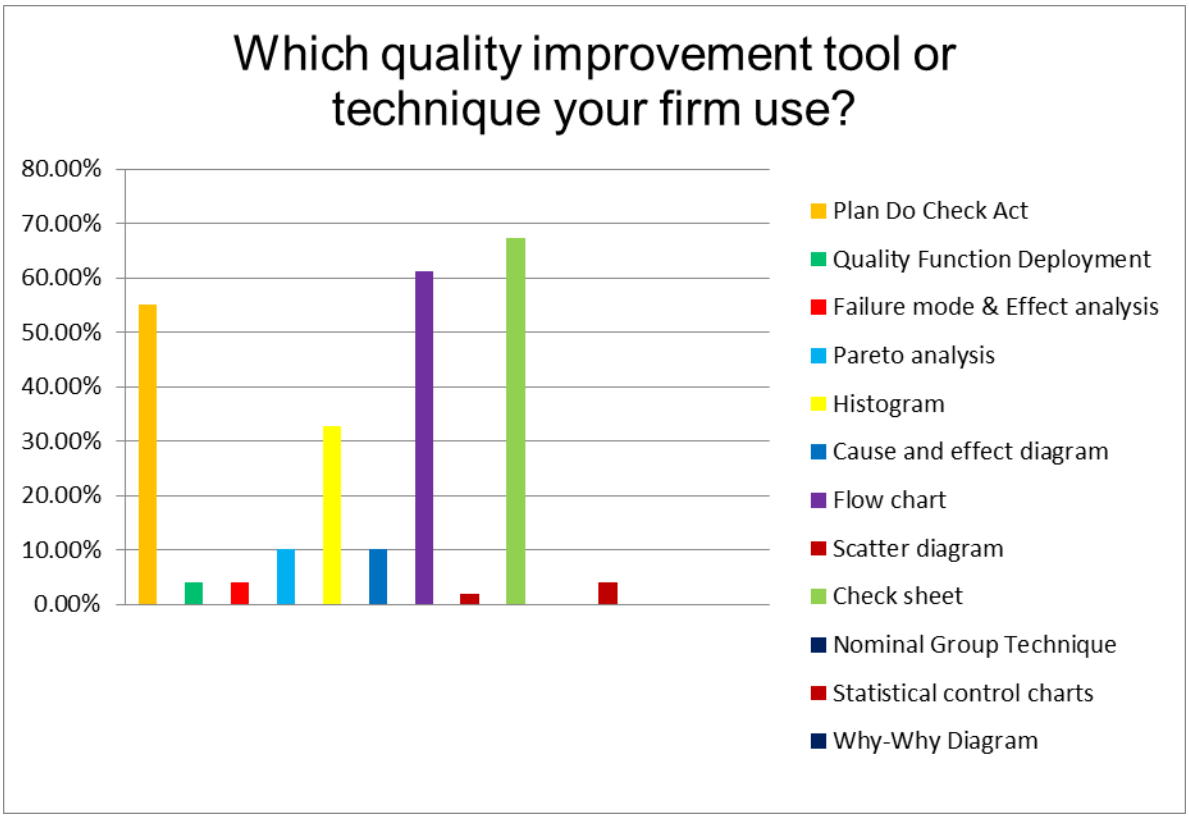


Figure 4.14 The quality improvement tools or techniques adopted in the surveyed firms

4.4.3 TQM Success Factor *(Managerial Level)*

In order to evaluate the TQM success factors in the surveyed firms, the respondents were asked to answer a set of questions based on the TQM practice in their firms. A Likert's five points (Strongly Disagree, Disagree, undecided, Agree and Strongly Agree) scale was used.

In this section, 32 statements were used to rate the TQM success factors application, in the investigated firms from the ***Managerial level*** point of view. The questions encompass six dimensions that were extracted from TQM elements: *Management leadership*, *Policy and strategy*, *Continuous improvement*, *Measurement and*

feedback, Subcontractors and suppliers' quality management, and Processes management. Means and standard deviations for each factor were calculated.

4.4.3.1 *"Leadership"* factor in the Construction of Mega Building Projects

The items related to ***Leadership*** were adopted from previous studies, mentioned in chapter 2. Respondents were requested to identify to what extent they agree or disagree with the given items regarding the implementation of this dimension in their firms.

Table 4.14 comprises eight statements used to examine the perception of the respondents regarding ***Leadership*** factor and are presented in terms of mean, standard deviation, and rank order.

Table 4.14 *Leadership* factor in the Construction of Mega Building Projects

Statement	Mean	SD	P-value	RII	Rank
Management build an improvement culture	4.381	0.498	0.275	0.876	1
Management act as key driver in continuous improvement	4.286	0.956	0.003	0.857	2
Management encourages communication between employees and suppliers/ subcontractors	4.238	0.831	0.013	0.848	3
Communication links established between employees and management	4.190	0.680	0.102	0.838	4
Clear mission is developed regarding business objectives	4.095	0.889	0.000	0.819	5

Statement	Mean	SD	P-value	RII	Rank
Management provide a proper and clear system to increase productivity	4.048	0.805	0.013	0.810	6
Employees are involved in the decision- making	3.810	1.209	0.055	0.762	7
Employees are empowered to make significant changes on their daily activity	3.762	0.889	0.002	0.752	8
Overall	**4.101**	**0.607**			

The result in table 4.14 show that the overall mean of ***Leadership*** factor, in the Construction of Mega Building Projects in Bahrain is 4.10 with a standard deviation of 0.607. This reveals that the level of ***Leadership*** factor in the Construction of Mega Building Projects in Bahrain is **High** compared with the ideal mean (5).

Additionally, the result show that the highest statement related to ***Leadership*** in the investigated firms is the statement "*Management build an improvement culture*" with a mean of 4.381. This indicates that leaders in these firms provide their subordinates with the support that by its turn digest it and integrate it into their culture in all the tasks and processes they are carrying and implementing.

Whilst, the lowest statement of ***Leadership*** in the Construction of Mega Building Projects in Bahrain is the statement *"Employees are empowered to make significant changes on their daily activity"* with a mean of 3.762. This indicates that some leaders are not inclined to delegate some authorities to their subordinates and they are not engaging their employees in decision-making.

4.4.3.2 *"Policy and Strategy"* factor in the Construction of Mega Building Projects

The statements related to ***Policy and Strategy*** were adopted from previous studies, mentioned in chapter 2. Respondents were requested to identify to what extent they agree or disagree with the given items regarding the implementation of this dimension in their firms.

Table 4.15 comprises four statements used to examine the perception of the respondents regarding ***Policy and Strategy*** factor and are presented in terms of mean, standard deviation, and rank order.

Table 4.15 *Policy and Strategy* factor in the Construction of Mega Building Projects

Statement	Mean	SD	P-value	RII	Rank
The concept of TQM is reflected in the firm's strategy, vision and mission	4.239	0.700	0.156	0.848	1
Management provide policies promoting customer satisfaction	4.237	0.995	0.011	0.848	2
Necessary resources available for achieving the firm's policy and strategy	3.952	0.805	0.018	0.790	3
The firm's policy and strategy are managed and reviewed on a regular basis	3.810	1.123	0.037	0.762	4
Overall of Policy and Strategy	**4.060**	**0.632**			

The result in table 4.15 illustrate that the overall mean of ***Policy and Strategy*** factor, in the Construction of Mega Building Projects in Bahrain is 4.06 with a standard deviation of 0.632. This reveals that the level of ***Policy and Strategy*** in the Construction of Mega Building Projects in Bahrain is **High** compared with the ideal mean (5).

The result also show that the highest statement related to ***Policy and Strategy*** in the Construction of Mega Building Projects in Bahrain is the statement *"The concept of TQM is reflected in the firm's strategy, vision and mission"* with a mean of 4.23. This indicates that these firms' strategic quality management is embedded in the midst of these firms' vision and mission.

Whilst, the lowest statement of ***Policy and Strategy*** in the Construction of Mega Building Projects in Bahrain is the statement *"The firm's policy and strategy are managed and reviewed on a regular basis"* with a mean of 3.810. This indicates that these firms perceive the necessity of setting policies and strategies while ignoring the vitality of reviewing them.

4.4.3.3 *"Continuous Improvement"* factor in the Construction of Mega Building Projects

The items related to ***Continuous Improvement*** were adopted from previous studies, as mentioned in chapter 2. Respondents were requested to identify to what extent they agree or disagree with the given items regarding the implementation of this dimension in their firms.

Table 4.16 comprises six statements used to examine the perception of the respondents regarding ***Continuous Improvement*** factor and are presented in terms of mean, standard deviation, and rank order.

Table 4.16 *Continuous Improvement* factor in the Construction of Mega Building Projects

Statement	Mean	SD	P-value	RII	Rank
Firm encourages innovation and creativity in process performance improvement	4.143	0.793	0.006	0.829	1
The firm processes are improved regularly	4.095	0.944	0.006	0.819	2
All Employees are trained to implement the continuous improvement philosophy in their daily activity	4.095	0.625	0.018	0.819	3
The quality improvement teams are effective	3.905	1.221	0.228	0.781	4
Sufficient training courses on quality improvement tools and techniques are provided.	3.476	1.250	0.406	0.695	5
Improvement teams exist in all functions	3.238	1.091	0.017	0.648	6
Continuous Improvement	**3.825**	**0.750**			

The result in table 4.16 show that the overall mean of ***Continuous improvement*** factor, in the Construction of Mega Building Projects in Bahrain is 3.825 with a standard deviation of 0.750. These results reveals that the level of Continuous improvement in the Construction of Mega Building Projects in Bahrain is **Moderately-high** compared with the ideal mean (5).

The result also show that the highest statement related to ***Continuous improvement*** in the Construction of Mega Building Projects in Bahrain is the statement *"Firm encourages innovation and creativity in process performance improvement"* with a mean of 4.14. This indicates that these firms have continuous endeavor to improve their operations and processes to remain creative and innovative.

Whilst, the lowest statement *"Improvement teams exist in all functions"* with a mean of 3.238. This indicates that not all the surveyed firms have improvement teams.

4.4.3.4 "Measurement and Feedback" factor in the Construction of Mega Building Projects

The items related to ***Measurement and Feedback*** were adopted from previous studies, mentioned in chapter 2. Respondents were requested to identify to what extent they agree or disagree with the given items regarding the implementation of this dimension in their firms.

Table 4.17 comprises five statements used to examine the perception of the respondents regarding ***Measurement and Feedback*** factor and are presented in terms of mean, standard deviation, and rank order.

Table 4.17 Measurement and Feedback factor in the Construction of Mega Building Projects

Statement	Mean	SD	P-value	RII	Rank
The main goal of performance measurement in our firm is to ensure that customer requirements have been met	4.190	0.981	0.013	0.838	1

Statement	Mean	SD	P-value	RII	Rank
Customer feedback is measured by customer surveys, focus groups, compliments and/or complaints	4.095	0.944	0.006	0.819	2
Employee's opinion and suggestions system is exist and considered in the improvement procedure	4.000	0.894	0.015	0.800	3
The firm provides employees performance appraisal	3.998	1.140	0.072	0.800	4
Data collection system monitors and predicts the improvement process	3.810	0.928	0.000	0.762	5
Overall Measurement and Feedback	**4.019**	**0.740**			

The result in table 4.17 show that the overall mean of ***Measurement and Feedback*** factor, in the Construction of Mega Building Projects in Bahrain is 4.019 with a standard deviation of 0.740. These results reveal that the level of ***Measurement and Feedback*** in the Construction of Mega Building Projects in Bahrain is **High** compared with the ideal mean (5).

The result also show that the highest statement related to ***Measurement and Feedback*** in the Construction of Mega Building Projects in Bahrain is the statement *"The main goal of performance measurement in our firm is to ensure that customer requirements have been met"* with a mean of 4.190. This indicates that these firms' tenet is that production of goods and services is founded on meeting their customers' current and future expectations.

Whilst, the lowest statement *"Data collection system monitors and predicts the improvement process"* with a mean of 3.810. This indicates that some of these firms

are not comprehending future customers ' demands and they are not using special means to assess their future satisfaction.

4.4.3.5 "Subcontractors and Suppliers Quality Management" factor in the Construction of Mega Building Projects

The items related to ***Subcontractors and Suppliers Quality Management*** were adopted from previous studies, mentioned in chapter 2. Respondents were requested to identify to what extent they agree or disagree with the given items regarding the implementation of this dimension in their firms.

Table 4.18 comprises five statements used to examine the perception of the respondents regarding ***Subcontractors and Suppliers Quality Management*** factor and are presented in terms of mean, standard deviation, and rank order.

Table 4.18 *Subcontractors and Suppliers Quality Management* in the Construction of Mega Building Projects

Statement	Mean	SD	P-value	RII	Rank
The firm works with subcontractors/suppliers towards long term partnerships	4.238	0.700	0.156	0.848	1
Quality aspects is the basis of Subcontractors/suppliers selection	4.048	1.161	0.005	0.810	2
Subcontractors/suppliers audit and evaluation are important activities to be conducted	3.952	0.669	0.000	0.790	3
Subcontractors/suppliers are involved in processes improvement	3.950	1.117	0.003	0.790	4

Statement	Mean	SD	P-value	RII	Rank
Subcontractors/suppliers provide reliable quality data	3.857	0.793	0.018	0.771	5
Overall Subcontractors and Suppliers Quality Management	**4.010**	**0.602**			

The result in table 4.18 show that the overall mean of ***Subcontractors and Suppliers quality management*** factor, in the Construction of Mega Building Projects in Bahrain is 4.01 and a standard deviation of 0.602. These results reveal that the level of ***Subcontractors and Suppliers quality management*** in the Construction of Mega Building Projects in Bahrain is **High** compared with the ideal mean (5).

The result also show that the highest statement related to ***Subcontractors and Suppliers quality management*** in the Construction of Mega Building Projects in Bahrain is the statement "*The firm works with subcontractors/suppliers towards long term partnerships"* with a mean of 4.238. This indicates that the surveyed firms are more opt to lessen variation in their processes, to reduce wastage and keep their inventory at acceptable rate.

Whilst, the lowest statement *"Subcontractors/suppliers provide reliable quality data"* with a mean of 3.857. This indicates that some of the Subcontractors/suppliers are not involved in the provision of data along or pre to the provision of materials and supplies.

4.4.3.6 *"Processes management" factor* in the Construction of Mega Building Projects

The items related to ***Processes Management*** were adopted from previous studies, mentioned in chapter 2. Respondents were requested to identify to what extent they agree or disagree with the given items regarding the implementation of this dimension in their firms.

Table 4.19 comprises four statements used to examine the perception of the respondents regarding ***Processes Management*** factor and are presented in terms of mean, standard deviation, and rank order.

Table 4.19 *Process Management* in the Construction of Mega Building Projects

Statement	Mean	SD	P-value	RII	Rank
Critical processes are improved	4.476	0.512	0.827	0.895	1
Critical processes are monitored	4.288	0.717	0.012	0.857	2
Critical processes are identified	4.284	0.956	0.003	0.857	3
Critical processes are designed and developed based on customer needs and expectations	4.190	0.928	0.002	0.838	4
Overall of Processes Management	**4.310**	**0.670**			

The result in table 4.19 show that the overall mean of ***Processes Management*** in the Construction of Mega Building Projects in Bahrain is 4.310 and a standard deviation of 0.670. These results reveal that the level of ***Processes Management*** in the Construction of Mega Building Projects in Bahrain is **High** compared with the ideal mean (5).

The result also show that the highest statement related to ***Processes Management*** in the Construction of Mega Building Projects in Bahrain is the statement *"Critical processes are improved"* with a mean of 4.47. This indicates that these firms are devising their process management approach and practices towards adding more value to both consumers and other shareholders

Whilst, the lowest statement *"Critical processes are designed and developed based on customer needs and expectations"* with a mean of 4.190. This indicates that few firms are not incorporating their customers' needs and expectations within the stage of process management.

4.4.4 TQM Success Factor *(Operational Level)*

In this section, 38 statements were used to rate the TQM success factors application in the investigated firms from the ***Operational level*** point of view. The questions encompass eight parameters: *Management leadership, Continuous Improvement, Measurement and Feedback, Subcontractors and Suppliers Quality Management, Processes Management, Resources Management, Education and Training, and Work Environment and Culture*. Means and standard deviations for each factor were calculated.

4.4.4.1 *"Leadership"* factor in the Construction of Mega Building Projects

The items related to ***Leadership*** were adopted from previous studies, mentioned in chapter 2. Respondents were requested to identify to what extent they agree or

disagree with the given items regarding the implementation of this dimension in their firms.

Table 4.20 comprises eight statements used to examine the perception of the respondents regarding ***Leadership*** factor and are presented in terms of mean, standard deviation, and rank order.

Table 4.20 *Leadership* factor in the Construction of Mega Building Projects

Statement	Mean	SD	P-value	RII	Rank
Management build an improvement culture	4.204	0.577	0.000	0.841	1
Management encourages communication between employees and suppliers/subcontractors	4.184	0.882	0.002	0.837	2
Management act as key driver in continuous improvement	4.020	0.777	0.000	0.804	3
Management provide a proper and clear system to increase productivity	3.918	0.954	0.000	0.784	4
Communication links established between employees and management	3.837	1.087	0.000	0.767	5
Clear mission is developed regarding business objectives	3.816	0.834	0.000	0.763	6
Employees are involved in the decision- making	3.531	1.101	0.000	0.706	7
Employees are empowered to make significant changes on their daily activity	3.469	1.063	0.000	0.694	8
The overall of Leadership	**3.872**	**0.644**			

The result in table 4.20 show that the overall mean ***Leadership*** factor in the Construction of Mega Building Projects in Bahrain is 3.872 with a standard

deviation of 0.644. This reveals that the level of ***Leadership factor*** in the Construction of Mega Building Projects in Bahrain is **Moderately-high** compared with the ideal mean (5).

Additionally, the result show that the highest statement related to ***Leadership*** in the investigated firms is the statement *"Management build an improvement culture"* with a mean of 4.20. This indicates that managers are deploying the culture of improvement as an engine that drive the transformation process towards quality in their firms.

Whilst, the lowest statement of ***Leadership*** in the Construction of Mega Building Projects in Bahrain is the statement *"Employees are empowered to make significant changes on their daily activity"* with a mean of 3.46. This indicates that some employees are lacking an extent of freedom in incorporating the changes they might initiate.

4.4.4.2 *"Continuous Improvement"* factor in the Construction of Mega Building Projects

The items related to ***Continuous Improvement*** were adopted from previous studies, mentioned in chapter 2. Respondents were requested to identify to what extent they agree or disagree with the given items regarding the implementation of this dimension in their firms.

Table 4.21 comprises six statements used to examine the perception of the respondents regarding ***Continuous Improvement*** factor and are presented in terms of mean, standard deviation, and rank order.

Table 4.21 *Continuous Improvement* factor in the Construction of Mega Building Projects

Statement	Mean	SD	P-value	RII	Rank
The firm processes are improved regularly	3.878	0.904	0.000	0.776	1
The quality improvement teams are effective	3.776	1.123	0.000	0.755	2
The firm encourages innovation and creativity in process performance improvement	3.673	1.088	0.001	0.735	3
All Employees are trained to implement the continuous improvement philosophy in their daily activity	3.429	1.137	0.036	0.686	4
Improvement teams exist in all functions	3.306	1.228	0.001	0.661	5
Sufficient training courses on quality improvement tools and techniques are provided	3.265	1.255	0.090	0.653	6
Overall of Continuous Improvement	**3.554**	**0.959**			

The result in table 4.21 show that the overall mean of ***Continuous improvement*** factor in the Construction of Mega Building Projects in Bahrain is 3.55 and a standard deviation of 0.959. These results reveals that the level of Continuous improvement in the Construction of Mega Building Projects in Bahrain is **High** compared with the ideal mean (5).

The result also show that the highest statement related to ***Continuous improvement*** in the Construction of Mega Building Projects in Bahrain is the statement *"The firm processes are improved regularly"* with a mean of 3.87. This indicates that these firms' processes are subject for continuous assessment to maintain a continuous improvement.

Whilst, the lowest statement *""Sufficient training courses on quality improvement tools and techniques are provided"* with a mean of 3.265. This indicates that some firms are not provided their staff with training problems pertinent to quality improvement.

4.4.4.3 *"Measurement and Feedback"* factor in the Construction of Mega Building Projects

The items related to ***Measurement and Feedback*** were adopted from previous studies, mentioned in chapter 2. Respondents were requested to identify to what extent they agree or disagree with the given items regarding the implementation of this dimension in their firms.

Table 4.22 comprises five statements used to examine the perception of the respondents regarding ***Measurement and Feedback*** factor and are presented in terms of mean, standard deviation, and rank order.

Table 4.22 Measurement and Feedback factor in the Construction of Mega Building Projects

Statement	Mean	SD	P-value	RII	Rank
The main goal of performance measurement in our firm is to ensure customer requirements have been met	4.204	0.735	0.000	0.841	1
Customer feedback is measured by customer surveys, focus groups, compliments and/or complaints	4.143	0.707	0.000	0.829	2
The firm provides employees performance appraisal	3.878	1.166	0.000	0.776	3
Data collection system monitors and predicts the improvement process	3.694	0.822	0.000	0.739	4

Statement	Mean	SD	P-value	RII	Rank
Employee's opinion and suggestions system is exist and considered in the improvement procedure	3.306	1.211	0.016	0.661	5
Overall Measurement and Feedback	**3.845**	**0.705**			

The results in table 4.22 show that the overall mean of application of Total Quality Management related to ***Measurement and Feedback*** in the Construction of Mega Building Projects in Bahrain is 3.845 with a standard deviation of 0.705. These results reveal that the level of ***Measurement and Feedback*** in the Construction of Mega Building Projects in Bahrain is **Moderately-high** compared with the ideal mean (5).

The result show that the highest statement related to ***Measurement and Feedback*** in the Construction of Mega Building Projects in Bahrain is the statement *"The main goal of performance measurement in the firm is to ensure customer requirements have been met"* with a mean of 4.204. This indicates that these firms' tenet is that production of goods and services is founded on meeting their customers' current and future expectations.

Whilst, the lowest statement *"Employee's opinion and suggestions system exist and considered in the improvement procedure"* with a mean of 3.306. This indicates that some firms are more inclined to adopt a centralization approach in terms of not integrating their employees' point of views in the improvement procedure.

4.4.4.4 "Subcontractors and Suppliers Quality Management" factor in the Construction of Mega Building Projects

The items related to ***Subcontractors and Suppliers Quality Management*** were adopted from previous studies, mentioned in chapter 2. Respondents were requested to identify to what extent they agree or disagree with the given items regarding the implementation of this dimension in their firms.

Table 4.23 comprises five statements used to examine the perception of the respondents regarding ***Subcontractors and Suppliers Quality Management*** factor and are presented in terms of mean, standard deviation, and rank order.

Table 4.23 *Subcontractors and Suppliers Quality Management* in the Construction of Mega Building Projects

Statement	Mean	SD	P-value	RII	Rank
The firm works with subcontractors/suppliers towards long term partnerships	4.102	0.714	0.000	0.820	1
Subcontractors/suppliers are involved in processes improvement	4.041	0.763	0.000	0.808	2
Quality aspects is the basis of Subcontractors/suppliers selection.	3.857	1.041	0.000	0.771	3
Subcontractors/suppliers audit and evaluation are important activities to be conducted	3.714	0.957	0.000	0.743	4
Subcontractors/suppliers provide reliable quality data	3.469	0.793	0.000	0.694	5
Overall Subcontractors and Suppliers Quality Management	**3.837**	**0.597**			

The results in table 4.23 show that the overall mean of ***Subcontractors and Suppliers quality management*** in the Construction of Mega Building Projects in Bahrain is 3.837 and a standard deviation of 0.597. These results reveal that the level of ***Subcontractors and Suppliers quality management*** in the Construction of Mega Building Projects in Bahrain is **Moderately-high** compared with the ideal mean (5).

The result show also that the highest statement related to ***Subcontractors and Suppliers quality management*** in the Construction of Mega Building Projects in Bahrain is the statement "*The firm works with subcontractors/suppliers towards long term partnerships"* with a mean of 4.102. This indicates that the surveyed firms are more opt to lessen variation in their processes, to reduce wastage and keep their inventory at acceptable rate.

Whilst, the lowest statement *"Subcontractors/suppliers provide reliable quality data"* with a mean of 3.469. This indicates that some of the Subcontractors/suppliers are not involved in the provision of data along or pre to the provision of materials and supplies.

4.4.4.4 "Processes management" factor in the Construction of Mega Building Projects

The items related to ***Processes Management*** were adopted from previous studies, mentioned in chapter 2. Respondents were requested to identify to what extent they agree or disagree with the given items regarding the implementation of this dimension in their firms.

Table 4.24 comprises four statements used to examine the perception of the respondents regarding ***Processes Management*** factor and are presented in terms of mean, standard deviation, and rank order.

Table 4.24 *Process Management* in the Construction of Mega Building Projects

Statement	Mean	SD	P-value	RII	Rank
Critical processes are improved	3.918	0.759	0.000	0.784	1
Critical processes are identified	3.898	0.770	0.000	0.780	2
Critical processes are designed and developed based on customer needs and expectations	3.878	0.726	0.000	0.776	3
Critical processes are monitored	3.653	0.779	0.000	0.731	4
Overall of Processes Management	**3.837**	**0.661**			

The result in table 4.24 show that the overall mean of ***Processes Management*** in the Construction of Mega Building Projects in Bahrain is 3.837 and a standard deviation of 0.661. These results reveal that the level of ***Processes Management*** in the Construction of Mega Building Projects in Bahrain is **Moderately-high** compared with the ideal mean (5).

Additionally, the result show that the highest statement related to ***Processes Management*** in the Construction of Mega Building Projects in Bahrain is the statement *"Critical processes are improved"* with a mean of 3.918. This indicates that these firms are devising their process management approach and practices towards adding more value to both consumers and other shareholders.

Whilst, the lowest statement *"Critical processes are monitored"* with a mean of 3.653. This indicates that some of the investigated firms do not have a mechanism to monitor the critical processes.

4.4.4.5 "Resources Management" in the Construction of Mega Building Projects

The items related to ***Resources Management*** were adopted from previous studies, mentioned in chapter 2. Respondents were requested to identify to what extent they agree or disagree with the given items regarding the implementation of this dimension in their firms.

Table 4.25 comprises four statements used to examine the perception of the respondents regarding ***Resources Management*** factor and are presented in terms of means, standard deviation, and rank order.

Table 4.25 *Resources Management* in the Construction of Mega Building Projects

Statement	Mean	SD	P-value	RII	Rank
Resources are effectively deployed in the development of firm's activities	3.776	0.919	0.001	0.755	1
Human resources is considered in improvement activities	3.714	1.000	0.000	0.743	2
Technical resources (e.g. software, equipment) are provided	3.571	1.118	0.000	0.714	3
Sufficient financial resources are provided to support the improvement activities	3.449	1.042	0.603	0.690	4
Overall of Resources Management	**3.628**	**0.877**			

The result in table 4.25 show that the overall mean of ***Resources Management*** in the Construction of Mega Building Projects in Bahrain is 3.628 and a standard deviation of 0.877. These results reveal that the level of ***Resources Management*** in the Construction of Mega Building Projects in Bahrain is **Medium** compared with the ideal mean (5).

Additionally, the result show that the highest statement related to ***Resources Management*** in the Construction of Mega Building Projects in Bahrain is the statement *"Resources are effectively deployed in the development of firm's activities"* with a mean of 3.776. This indicates that resources, particularly human resources are used efficiently to improve employees' performance. Thereby, enhancing the activities handled by these firms.

Whilst, the lowest statement *"Sufficient financial resources are provided to support the improvement activities"* with a mean of 3.44. This indicates that some of the firms are not properly financing the improvement activities.

4.4.4.6 "Education and Training" in the Construction of Mega Building Projects

The items related to ***Education and Training*** were adopted from previous studies, mentioned in chapter 2. Respondents were requested to identify to what extent they agree or disagree with the given items regarding the implementation of this dimension in their firms.

Table 4.26 comprises four statements used to examine the perception of the respondents regarding ***Education and Training*** factor and are presented in terms of mean, standard deviation, and rank order.

Table 4.26 *Education and Training* in the Construction of Mega Building Projects

Statement	Mean	SD	P-value	RII	Rank
Employees are trained for the needed job skills set	3.592	1.153	0.000	0.718	1
Continuous learning is provided through education and training courses	3.551	1.174	0.000	0.710	2
Sufficient training time is provided for employees	3.122	1.252	0.076	0.624	3
Employees are trained on TQM concepts	2.898	1.104	0.001	0.580	4
Overall of Education and Training	**3.291**	**1.085**			

The result in table 4.26 show that the overall mean of ***Education and Training*** in the Construction of Mega Building Projects in Bahrain is 3.291 and a standard deviation of 1.085. These results reveal that the level of ***Education and Training*** in the Construction of Mega Building Projects in Bahrain is **Medium** compared with the ideal mean (5).

Additionally, the result show that the highest statement related to ***Education and Training*** in the Construction of Mega Building Projects in Bahrain is the statement *"Employees are trained for the needed job skills set"* with a mean of 3.592. This indicates that there is a strong inclination from these firms to equip their employees with the skills and competencies needed, to achieve the objectives of their assigned duties.

Whilst, the lowest statement *"Employees are trained on TQM concepts"* with a mean of 2.898. This indicates that more focus is given by these firms to train employees,

to acquire the skills and knowledge to perform the assigned duties, while less consideration is given to quality relevant training courses.

4.4.4.7"Work Environment and Culture" in the Construction of Mega Building Projects

The items related to ***Work Environment and Culture*** were adopted from previous studies, mentioned in chapter 2. Respondents were requested to identify to what extent they agree or disagree with the given items regarding the implementation of this dimension in their firms.

Table 4.27 comprises two statements used to examine the perception of the respondents regarding ***Work Environment and Culture*** factor and are presented in terms of mean, standard deviation, and rank order.

Table 4.27 Work Environment and Culture in the Construction of Mega Building Projects

Statement	Mean	SD	P	RII	Rank
Employees have good compliance to the quality culture change	4.102	0.653	0.001	0.820	1
The current statues motivates employees to contribute towards building a quality culture	3.510	1.157	0.004	0.702	2
The overall of Work Environment and Culture	**3.806**	**0.783**			

The result in table 4.27 show that the overall mean of ***Work Environment and Culture*** in the Construction of Mega Building Projects in Bahrain is 3.806 and a standard deviation of 0.783. These results reveal that the level of ***Work environment***

and culture in the Construction of Mega Building Projects in Bahrain is **Moderately-high** compared with the ideal mean (5).

Additionally, the result show that the highest statement related to ***Work Environment and Culture*** in the Construction of Mega Building Projects in Bahrain is the statement *"Employees have good compliance to the quality culture change"* with a mean of 4.102. This indicates that there is no resistance from the part of employees to abide to the changes brought by the quality culture.

This followed by *"The current statues motivate employees to contribute towards building a quality culture"* with a mean of 3.510. This indicates that some firms' employees lack the motivation towards building, such as quality' culture.

4.4.5 Critical Success Factors (CSF) of TQM implementation in the Construction of Mega Building Projects

This section is a common measure combining the overall population of the survey that encompass both managerial and operational.

To determine the ***Critical Success Factors*** of TQM Implementation in the construction of mega buildings in Bahrain, 23 Factors that were summarized earlier in chapter 4. Respondents were asked to rank those factors in order of importance. Five points Likert scale for importance was used, then data analyzed by calculating mean and standard deviation.

Table 4.28 Critical Success Factors

Success Factors	Mean	SD	P	RII	Rank
Top management’s commitment	4.800	0.499	0.000	9.600	1
Understanding of client's requirements and expectations of the project outcome	4.786	0.413	0.000	9.571	2
Planning realistically for time, budget, material and human resources	4.714	0.542	0.000	9.429	3
Quality education and training	4.700	0.521	0.000	9.400	4
Teamwork	4.688	0.468	0.000	9.371	5
Continuous improvement	4.686	0.526	0.000	9.371	6
Communication between top managers and employees	4.557	0.555	0.002	9.114	7
Measuring customer satisfaction periodically	4.543	0.557	0.000	9.086	8
Process management	4.529	0.558	0.000	9.057	9
Time management	4.457	0.530	0.000	8.914	10
Organizational culture	4.429	0.579	0.000	8.857	11
Employees’ involvement	4.371	0.618	0.000	8.743	12
Employees’ satisfaction	4.371	0.618	0.000	8.743	12
Company's quality policy	4.371	0.543	0.000	8.743	12
Employees empowerment	4.329	0.675	0.001	8.657	15
Subcontractors and suppliers assessment procedures	4.286	0.593	0.000	8.571	16

Success Factors	Mean	SD	P	RII	Rank
Long-term relationships with subcontractors and suppliers	4.214	0.657	0.000	8.429	17
Build long-term relationships With clients	4.200	0.734	0.000	8.400	18
Innovation strategy	4.029	0.701	0.000	8.057	19
Availability of comprehensive quality information	3.900	0.684	0.000	7.800	20
Quality to be assessed at recruitment stage for skilled labors	3.857	0.748	0.000	7.714	21
Business environment	3.829	0.701	0.000	7.657	22
Sharing lessons learned to understand how to evaluate quality processes for improvement	3.757	0.731	0.000	7.514	23
Overall of Critical Success Factors	**4.365**	**0.312**			

The result in table 4.28 show that the overall mean of the ***Critical Success Factors*** of TQM implementation in the Construction of Mega Building Projects in Bahrain 4.365 and a standard deviation of 0.312. These results reveal that the level of ***Critical Success Factors*** of TQM implementation in the Construction of Mega Building Projects in Bahrain was **High** compared with the ideal mean (5).

Additionally, the result show that the most important ***Critical Success Factors*** of TQM implementation in the construction of mega buildings in Bahrain are respectively: *"Top management's commitment and leadership"* with a mean of 4.8. This indicates that the support provided by top management and commitment of leaders of those firms promote the quality's culture and improve the competences of employees in performing the assigned tasks.

Whilst, the lowest statement *"Sharing lessons learned to understand how to evaluate quality processes for improvement"* with a mean of 3.757. This indicates that top management are not exchanging with their employees' thoughts regarding the assessment of quality processes for improvement.

4.4.6 TQM implementation (Organizational Performance)

This section is a common measure combining overall population of the survey that encompass both managerial and operational.

To determine the extent of ***TQM Implementation*** in the construction of mega buildings in Bahrain, 17 items that were summarized earlier in previous chapter 2 were used.

Respondents were requested to rank the given items in order of importance. Five points Likert scale for importance was used then data analyzed by calculating mean and standard deviation.

4.4.6.1 TQM implementation (Organizational Performance) in the Construction of Mega Building Projects

To determine the ***TQM Implementation***, the mean and standard deviation were calculated.

Table 5.29 TQM Implementation

TQM Area	Mean	SD	P	RII	Rank
The productivity has improved	4.743	0.472	0.000	0.949	1
Timely completion of the project	4.741	0.530	0.000	0.949	2
Customer satisfaction has increased	4.700	0.574	0.000	0.940	3

TQM Area	Mean	SD	P	RII	Rank
Employees performance has improved	4.686	0.498	0.000	0.937	4
The profit has increased (Profit maximization)	4.459	0.606	0.000	0.891	5
Employees job satisfaction and motivation has increased	4.457	0.630	0.000	0.891	6
Positive change in employees skills, knowledge and abilities	4.457	0.606	0.000	0.891	7
The competitive position of your company has strengthened	4.429	0.627	0.000	0.886	8
The waste has reduced	4.400	0.575	0.000	0.880	9
Improved and innovative processes cause efficiency improvement	4.400	0.623	0.000	0.880	9
Production deficiencies reduction	4.286	0.568	0.000	0.857	10
The firm's overall market share has increased	4.214	0.587	0.000	0.843	11
The occupational accidents minimized	4.200	0.580	0.000	0.840	12
Increased client loyalty and retention and reduced customer complaints	4.057	0.657	0.000	0.811	13
Change order has reduced	3.986	0.625	0.000	0.797	14
Adaptability to changing or emerging market conditions and government regulations	3.829	0.722	0.000	0.766	15
Employee turnover has decreased	3.629	0.726	0.000	0.726	16
Overall TQM Implementation	**4.334**	**0.362**			

The result in table 4.29 show that the overall mean of the ***TQM Implementation*** in the Construction of Mega Building Projects in Bahrain is 4.334 with a standard deviation of 0.362. These results reveal that the level of ***TQM implementation*** in the Construction of Mega Building Projects in Bahrain is **High** compared with the ideal mean (5).

The result also show that the most ranked ***area of improvement of TQM Implementation*** in the Construction of Mega Building Projects in Bahrain are respectively: *"Increased productivity"* with a mean of 4.743. This indicates that raising the productivity is among the top desirable outcome that these firms are aspiring to achieve.

Whilst, the lowest statement "Employee turnover has decreased" with a mean of 3.62. This indicates that some of the surveyed firms still did not have a reduced rate of employee turnover.

4.4.6.2 Barriers of TQM implementation in the Construction of Mega Building

To determine the ***Barriers of TQM Implementation***, mean and standard deviation were calculated.

Table 4.30 Barriers of TQM implementation

Barriers	Mean	SD	P	RII	Rank
Lack or insufficient education and training	4.686	0.603	0.000	0.937	1
Lack of top-management commitment	4.657	0.720	0.000	0.931	2
Lack of communication between top managers and employees	4.514	0.608	0.000	0.903	3
Poor performance of contractors / sub-contractors	4.486	0.676	0.004	0.897	4
Lack of long-term sustainability	4.471	0.631	0.000	0.894	5
Improper planning and scheduling	4.414	0.691	0.005	0.883	6
Incompetence of project team	4.386	0.597	0.000	0.877	7
Need for conducting continuous training programs for employee	4.371	0.706	0.000	0.874	8

Barriers	Mean	SD	P	RII	Rank
Challenges in changing organizational culture	4.357	0.615	0.000	0.871	9
Lack of employees' involvement	4.343	0.535	0.000	0.869	10
Low bid subcontractors selection (low bid mindset)	4.286	0.871	0.000	0.857	11
Lack of knowledge and ability in managing construction projects	4.286	0.684	0.001	0.857	12
Lack of integration between TQM and existing systems	4.243	0.647	0.000	0.849	13
frequent design changes	4.229	0.888	0.000	0.846	14
Lack of financial and/or human resources	4.057	0.700	0.000	0.811	15
Lack of experience in complex projects	4.043	0.731	0.000	0.809	16
Poor design capacity	4.029	0.816	0.034	0.806	17
Lack of a systematic approach to manage the project	4.029	0.701	0.045	0.806	18
lack of integration of internal and external customer-supplier chains	3.971	0.636	0.000	0.794	19
Perception of costly and time consuming of TQM application	3.743	1.003	0.000	0.749	20
Incompatibility of standardized quality management system with the construction industry	3.700	0.667	0.021	0.740	21
Financial difficulties of owner	3.571	0.791	0.000	0.714	22
Corruption and bribery in construction projects	3.543	0.943	0.000	0.709	23
The delays in payment	3.400	0.891	0.006	0.680	24
Economic volatility	3.086	1.032	0.000	0.617	25
Government policies and regulations	2.857	1.266	0.000	0.546	26

Barriers	Mean	SD	P	RII	Rank
Heavy documentation needed	2.729	1.179	0.000	0.571	27
Overall of Barriers of TQM Implementation	**4.018**	**0.377**			

The result in table 4.30 show that the overall mean of the ***Barriers of TQM Implementation*** in the Construction of Mega Building Projects in Bahrain is 4.018 with a standard deviation of 0.377. These results reveal that the level of ***Barriers of TQM implementation*** in the Construction of Mega Building Projects in Bahrain is **High** compared with the ideal mean (5).

The result also show that the most ranked ***Barriers of TQM Implementation*** in the Construction of Mega Building Projects in Bahrain are respectively: *"Lack or insufficient education and training"* with a mean of 4.68. This indicates that lacking the proper education and insufficient training will prohibit employees to comprehend the importance of TQM.

Whilst, the lowest statement “Heavy documentation needed” with a mean of 2.72. This indicates that many of the physical documentation relevant with the implementation of TQM was replaced by electronic format.

4.5 Correlation Analysis

To identify the significance of the relationship between success factors and TQM implementation, the correlation coefficient was calculated.

4.5.1 Correlation analysis for the managerial survey

The results in table 4.31 show that there is a significant positive relationship between Success factors and TQM implementation in the Construction of Mega Building Projects among **Managers sample** (α =0.001, r=0.879), this result indicates that an increase in Success Factors in the Construction of Mega Building Projects leads to an increase in TQM implementation in these Projects.

Table 4.31

Pearson Correlation Coefficient between Success factors and TQM implementation

Variables	Dimensions of Success factors						Total
	Leadership	Policy and Strategy	Continuous Improvement	Measurement and Feedback	Subcontractors and suppliers	Processes Management	
TQM Implementation	0.492(*)	.788(**)	.635(**)	.611(**)	.436(*)	0.434(*)	0.879(**)
Sig.	0.041	0.001	0.002	0.003	0.048	0.050	0.001

**. Correlation is significant at the 0.01 level

*. Correlation is significant at the 0.05 level.

The results also show, that there is a significant positive relationship between all success factors dimensions (Leadership, Policy and Strategy, Continuous Improvement, Measurement and Feedback, Subcontractors and Suppliers Quality

Management, Processes Management) and TQM implementation in the Construction of Mega Building Projects among Managers sample. The highest relationship was between "Policy and Strategy" and TQM implementation (α =0.001, r=0.788), followed by Continuous Improvement (α =0.002, r=0.635), and Measurement and Feedback (α =0.003, r=0.611), respectively.

4.5.2 Correlation analysis for the operational survey

The results table 4.32 show that there is a significant positive relationship between Success factors and TQM implementation in the Construction of Mega Building Projects among **Operational sample** (α =0.001, r=0.628), this result indicates that an increase in Success Factors in the Construction of Mega Building Projects leads to an increase in TQM implementation in these Projects.

The results also show, that there is a significant positive relationship between Success factors (Leadership, Continuous Improvement, Measurement and Feedback, Subcontractors and suppliers quality management, Processes Management, Resources Management, Education and training, Work environment and culture) and TQM implementation in the Construction of Mega Building Projects among Operational sample. The highest relationship was between "Resources Management" and TQM implementation (α =0.001, r=0.599), followed by Work environment and culture (α =0.001, r=0.759), and Continuous Improvement and TQM implementation (α =0.001, r=0.566), respectively.

Table 4.32

Correlation analysis between Success factors and TQM implementation

Variables	Dimensions of Success factors								
	Leadership	**Continuous Improvement**	**Measurement and Feedback**	**Subcontractors and suppliers quality management**	**Processes Management**	**Resources Management**	**Education and training**	**Work environment and culture**	**Total**
TQM Implementation	.483(**)	.566(**)	.427(**)	.541(**)	.519(**)	.599(**)	.386(**)	.579(**)	0.628(**)
Sig.	0.001	0.001	0.002	0.001	0.001	0.001	0.006	0.001	0.001

**. Correlation is significant at the 0.01 level

*. Correlation is significant at the 0.05 level.

The result of correlation analysis of both surveys (managerial and operational) showed that there is a positive significant relationship between success factors and TQM implementation in the Construction of Mega Building Projects in Bahrain. This result is in agreement with the results of previous studies (Salama and Swareldahab, 2019; Al Mannai et al., 2016; Subramani et al., 2019; Salleh et al., 2018).

4.6 Regression Analysis

To identify the volume of the impact of the success factors on TQM implementation, the multiple regression was calculated.

4.6.1 Regression analysis for the managerial survey

The results in table 4.33 show that Success factors are able to predict the level of TQM implementation in the Construction of Mega Building Projects (α =0.001, F=7.945).

The results of multiple regression also reveal that the Success factors are able to predict (67.6%) of the variance in TQM implementation in the Construction of Mega Building Projects (Adj R2 =0.676).

Table 4.33

Multiple Regression analysis between Success factors and TQM implementation from the managers' perspective

Model	Sum of Squares	df	Mean Square	R	(R^2) Regression coefficient	Adj R	F - value	P-value	Sig. level
Regression	0.989	6	0.165	0.879(**)	0.773	0.676	7.945	0.001	0.001
Residual	0.291	14	0.021						
Total	1.280	20							

**. Correlation is significant at the 0.01 level

The results in table 4.34 show that the highest factor that was able to predict the TQM implementation in the Construction of Mega Building Projects is the Policy and Strategy factor (α =0.001, β =0.790), followed by Continuous Improvement (α =0.039, β =0.592), and Leadership factor (α =0.049, β =0.508), respectively.

Table 4.34
Output of Coefficients for the Multiple Regressions of the managerial survey

Variable	B	β	t- value	Sig
(Constant)	2.832		9.095	0.000
Leadership	0.204	0.508	2.412	0.049
Policy and Strategy	0.381	0.790	3.939	0.001
Continuous Improvement	0.231	0.592	2.527	0.039
Measurement and Feedback	0.106	0.257	1.041	0.316
Subcontractors and suppliers	0.157	0.390	1.543	0.145
Processes Management	0.138	0.286	1.369	0.193

4.6.2 Regression analysis for the operational survey

The results in table 4.35 show that Success factors are able to predict the level of TQM implementation in the Construction of Mega Building Projects (α =0.01, F=6.839).

The results of multiple regression also reveal that the Success factors are able to predict (33.7%) of the variance in TQM implementation in the Construction of Mega Building Projects (Adj R2 =0.337).

The results in table 4.36 that the highest factor that was able to predict the TQM implementation in the Construction of Mega Building Projects is the Resources Management factor (α =0.007, β =0.516), followed by Continuous Improvement factor (α =0.013, β =0.419), and Work environment and culture (α =0.009, β =0.384), respectively.

Table 4.35 Multiple Regression analysis between Success factors and TQM implementation from the employees' perspective

Model	Sum of Squares	df	Mean Square	R	(R^2) Regression coefficient	Adj R	F - value	P- value	Sig. level
Regression	3.000	8	.375	0.628(**)	0.394	0.337	6.839	0.000	0.001
Residual	4.606	84	.055						
Total	7.606	92							

**. Correlation is significant at the 0.01 level

The result of multiple regression analysis of both surveys (managerial and operational) showed that there is a positive significant impact of success factors on TQM implementation in the Construction of Mega Building Projects in Bahrain. This result is in agreement with the results of previous studies (Ahmed and Taib, 2019; Salama and Swareldahab, 2019; Al Mannai et al., 2016; Nadim and Al-Hinai, 2016; Nair and Choudhary, 2016; Al-Sabek, 2015; Alotaibi and Islam 2013).

Table 4.36 Output of Coefficients for the Multiple Regressions of the operational survey

Variable	B	β	t- value	Sig
(Constant)	3.190		14.469	0.000
Leadership	0.065	0.138	0.820	0.414
Continuous Improvement	0.168	0.419	2.532	0.013
Measurement and Feedback	0.049	0.121	0.761	0.449
Subcontractors and suppliers	0.020	0.040	0.232	0.817
Processes Management	0.003	0.007	0.049	0.961

Resources Management	0.189	0.516	2.763	0.007
Education and training	0.013	0.040	0.171	0.865
Work environment and culture	0.114	0.384	2.682	0.009

4.7 Differences according to firms that adopt Quality System and firms that adopt TQM

To determine if there is any statistical significance between firms that adopt Quality system and the firms that adopts TQM, the means, standard deviations and t test of the responses of the sample were calculated for firms that adopt Quality System and firms that adopts TQM, as illustrated below in table 4.37.

Table 4.37 Significance of the Differences between firms that adopt Quality System and firms that adopt TQM

Scale	TQM	N	Mean	SD	t	df	Sig.
Leadership	yes	11	4.011	0.719	-0.702	19	0.491
	no	10	4.200	0.472			
Policy and strategy	yes	11	4.114	0.761	0.403	19	0.692
	no	10	4.000	0.486			
Continuous improvement	yes	11	3.879	0.847	0.334	19	0.742
	no	10	3.767	0.668			
Measurement and feedback	yes	11	4.018	0.817	-0.005	19	0.996
	no	10	4.020	0.689			
Subcontractors and suppliers quality management	yes	11	4.018	0.642	0.067	19	0.947
	no	10	4.000	0.589			
Processes management	yes	11	4.227	0.855	-0.580	19	0.569
	no	10	4.400	0.412			
Critical Success Factors of TQM implementation	**yes**	**11**	**4.573**	**0.150**	**2.484**	**19**	**0.022**
	no	**10**	**4.313**	**0.310**			
TQM	yes	11	4.492	0.230	1.857	19	0.079

implementation	no	10	4.265	0.327			
Barriers to TQM implementation	yes	11	4.145	0.368	1.266	19	0.221
	no	10	3.937	0.383			

The result show that there are no statistically significant differences according to the quality system that firms adopt in all sub scales, **except** for "Critical Success Factors of TQM implementation" dimension for the advantage of using Total Quality Management (TQM).

4.8 Research Findings

- The results of this chapter show that the best definition of Quality according to sample is "Meet customer expectations" and "Meet standards and codes", the operational sample believes that the "ISO standards is a part of TQM".

- The highest priority policy of the construction projects at firm according to Operational sample is "Within budget" and "Customer satisfaction".

- The most quality improvement tools or techniques using by firms is the "Check sheet", followed by "Flow chart", then “Plan Do Check Act".

- The results revealed that the level of application of Total Quality Management related to leadership in the Construction of Mega Building Projects in Bahrain was high. The most application of the Total Quality management related to leadership in is the "Management build an improvement culture", followed by "Management act as key driver in continuous improvement".

- The level of application of Total Quality Management related to Policy and strategy in the Construction of Mega Building Projects in Bahrain was high. The most application of the Total Quality management related to Policy and

strategy is the statement "The concept of TQM is reflected in the firm's strategy, vision and mission", followed by "Management provide policies promoting customer satisfaction".

- The level of application of Total Quality Management related to Continuous improvement in the Construction of Mega Building Projects in Bahrain was high. The most application of Total Quality management related to Continuous improvement is the statement "Firm encourages innovation and creativity in process performance improvement", followed by "The firm processes are improved regularly".

- The level of application of Total Quality Management related to Measurement and feedback in the Construction of Mega Building Projects in Bahrain was high. The most application of the Quality management related to Measurement and feedback is the statement "The main goal of performance measurement in our firm is to ensure that customer requirements have been met", followed by "Customer feedback is measured by customer surveys, focus groups, compliments and/or complaints".

- The level of application of Total Quality Management related to "Subcontractors and suppliers' quality management" in the Construction of Mega Building Projects in Bahrain was high. The most application of the Total Quality management related to "Subcontractors and suppliers' quality management" is the statement "The firm works with subcontractors/suppliers towards long term partnerships", followed by "Quality aspects is the basis of Subcontractors/suppliers selection".

- The level of application of Total Quality Management related to Processes management in the Construction of Mega Building Projects in Bahrain was high. The most application of the Quality management related to Processes management in the Construction of Mega Building Projects in Bahrain is the statement "Critical processes are improved", followed by "Critical processes are monitored".

- The level of implementation of the Critical Success Factors of TQM in the Construction of Mega Building Projects in Bahrain was high. The most Critical Success Factors of TQM implementation is "Top management's commitment and leadership", followed by "Understanding of client's requirements and expectations of the project outcome", then "Planning realistically for time, budget, material and human resources".

- The results also indicated that the level of TQM implementation in the Construction of Mega Building Projects in Bahrain was high. The highest facet of TQM implementation is the statement "Increased productivity", followed by "Timely completion of the project", then "Increased customer satisfaction".

- The results revealed that the level of Barriers of TQM implementation in the Construction of Mega Building Projects in Bahrain was high. The prominent barriers of TQM implementation in the Construction of Mega Building Projects in Bahrain is the "Lack of top-management commitment", followed by "Lack of communication between top managers and employees", then "Poor performance of contractors/ sub-contractors".

4.9 Discussion of results

- The result of the correlation analysis of both surveys (managerial and operational) showed that there is a positive significant relationship between success factors and TQM implementation in the Construction of Mega Building Projects in Bahrain. This result is in agreement with the results of previous studies (Salama and Swareldahab, 2019; Al Mannai et al., 2016; Subramani et al., 2019; Salleh et al., 2018).

- The result of multiple regression analysis of both surveys (managerial and operational) showed that there is a positive significant impact of success factors on TQM implementation in the Construction of Mega Building Projects in Bahrain. This result is in agreement with the results of previous studies (Ahmed and Taib, 2019; Salama and Swareldahab, 2019; Al Mannai et al., 2016; Nadim and Al-Hinai, 2016; Nair and Choudhary, 2016; Al-Sabek, 2015; Alotaibi and Islam 2013).

    - In terms of Policy and Strategy factor, it was the highest influential factor from the managerial perspective, this result is in agreement with the results revealed by previous studies (Ahmed and Taib, 2019; Salleh et al., 2018; Bouranta et al., 2017; Goharshenasan and Shahin, 2017; Yazdani et al., 2014).
    - In terms of Continuous Improvement factor, it was the second influential factor from both the managerial and employees' perspective, this result is in agreement with the results revealed by (Salama and Swareldahab, 2019).

- In terms of leadership factor, it was the third influential factor from the managerial' perspective, this result is in agreement with the results revealed by (Ahmed and Taib, 2019; Kaur et al., 2019; Jusoh et al., 2018; Utam and Harahap, 2018; Bouranta et al., 2017; Goharshenasan and Shahin, 2017; Zylfijaj and Pira, 2017; Nair and Choudhary, 2016; Al-Sabek, 2015; Yazdani et al., 2014**;** Alotaibi and Islam 2013)
- In terms of Resources Management factor, it was the highest influential factor from the operational' perspective, this result is in agreement with the results revealed by (Dubey et al., 2015).
- In terms of Work environment and culture factor, it was the third influential factor from the operational' perspective, this result is in agreement with the results revealed by previous studies (Salama and Swareldahab, 2019; Jusoh et al., 2018; Utam and Harahap, 2018; Salleh et al., 2018; Goharshenasan and Shahin, 2017; Kumar and Sharma, 2017; Zylfijaj and Pira, 2017; Al-Sabek, 2015).

4.10 Recommendations

In this section, some recommendations are proposed based on survey findings, interviews, study of implementation level and barriers, and relationship analysis, to help the contractors improve their process of TQM implementations in order to achieve high level of work efficiency.

1. Empower employees by delegating them the authority to initiate changes into their job activities unless these changes will not affect any quality aspect, by doing so employees will feel ownership of their decision in taking these imitative and they will be triggered to generate novel ideas.

2. Review the firm’s policies frequently to enable them to deal proactively with the available resources to alleviate threats, and incorporating their decision making to address uncertainties that is implied within their dynamic business environment. Request subcontractors/suppliers to provide inputs in terms of quality pertinent data which can be created through establishing a mutual quality culture and to be communicated between these firms and subcontractors/suppliers, thus reinforcing the conception of partnership between these parties.

3. Recruit improvement teams at all the firm hierarchical level with clearly articulated goals, whose responsibility is to initiate novel ideas for further improvements at the operational level of each department.

4. Investigate customers ' trends, anticipations, follow up on negative comments or complaints and incorporate their views during the development of a product or service. That can be accomplished through filling customer satisfaction surveys and enabling them to express their suggestions for further quality improvement.

5. Request subcontractors/suppliers to provide inputs in terms of quality pertinent data which can be created through establishing a mutual quality culture and to be communicated between these firms and subcontractors/suppliers. Thus reinforcing the conception of partnership between these parties.

6. Establish a mechanism oriented towards receiving customers’ specific needs and preferences and digest them into a specific format that ensure that the

design and development of critical processes will fulfill these needs and expectations.

7. Review the policies and practices relevant with improvement process and encouraging employees of these firms to have a voice in the suggestion of new ideas that might reinforce the improvement process.

8. Benchmark other similar construction companies worldwide particularly in the mechanism they pursue in monitoring the critical processes and to turn to adopting this mechanism, which will promote the quality of products and services delivered and preventing errors that might lead to deficiencies.

9. Assign adequate financing in terms of proper budget, to support carrying on any needed improvement, to avoid revealing any deficiencies within the phase of production and facing an obstacle in terms of unavailable funds to finance these needed improvements.

10. Design yearly training plan dedicated mainly to acquire employees of these firms with the particular knowledge, expertise, and skills allied with TQM tasks. Thus, ensuring employees will be motivated to be engaged in quality-oriented attitudes once they realized that these training programs highly provide the entire quality goals.

11. Invite all employees working in the firm in a gathering with the top management, to highlight that building a quality culture is a collective responsibility of both parties and to stimulate employees' engagement in

developing this quality culture by highlighting their valuable contribution towards the achievement of their firms' objectives and to its potential success.

12. Direct managers in these firms to start sharing learned lessons from assessing TQM with their subordinates and to engage the latter to exchange their insights regarding how to raise the effectiveness of quality processes. By doing so, employees might feel triggered to generate initiative that might have positive potentials towards the improvement of quality processes.

13. Deploy exit survey to be filled by employees upon resigning from their firms to reveal the reasons behind quitting their firms. To start dealing with these issues and their causes, and solve it, in order to increase employees' retention.

14. Enroll employees in customized training, will allow them to acquire all necessary skills and competencies that will reinforce their continuous improvement endeavors.

4.11 Chapter summary

This chapter presents the results, analysis and findings of the data collected through the distributed questionnaires. The raw data collected were analyzed using Statistical Package for Social Science (SPSS) software version 23.

From the questionnaire, the Critical Success Factors of TQM implementation were ranked and the most Critical Key Factors that improve the effectiveness of TQM implementation in construction projects were identified. In additional, nine elements of TQM were assessed and ranked according to the implementation level.

These data will be used as preliminary information to extract the essential information needed to develop the forecasting model of the effective TQM implementation.

CHAPTER 5
Data collection, Design and Results of Questionnaire 2

5.1 Introduction

5.2 Data collection

5.3 Questionnaire design and development

5.4 Questionnaire Results

5.5 Chapter Summary

Chapter 5
Data collection, Design and Results of Questionnaire 2

5.1 Introduction

This chapter introduces the method and procedures pursued to elicit the data needed for developing a forecasting model for the effective TQM implementation in the construction field, using the information obtained from the previously conducted questionnaire.

5.2 Data Collection

The aim of the data collection for this part of the research is to choose the most applicable data from the previous questionnaire and use it to gather the data needed to produce the effective forecasting model of TQM implementation.

5.2.1 Approach to Data Collection

In the previous questionnaire conducted for this study, the Critical Success Factors of TQM implementation were ranked and the most Critic al Key Factors that improve the effectiveness of TQM implementation in construction projects were identified. In additional, nine elements of TQM were assessed and ranked according to the implementation level.

These data were used as preliminary information to extract the essential information needed to develop the Forecasting model of the effective TQM implementation.

5.2.2 Selection of Data Collected

The Critical Success Factors of TQM implementation founded as the most Critical Key Factors that affects the effectiveness of TQM implementation in construction projects and the highly ranked factors were selected. According to this, the following ten factors were the bases of the assessment.

- Top management’s commitment
- Understanding of client's requirements and expectations of the project outcomes
- Planning realistically for time, budget, material and human resources
- Quality education and training
- Teamwork
- Continuous improvement
- Communication between top managers and employees
- Measuring customer satisfaction periodically
- Process management
- Time management

Conversely, nine elements of TQM were assessed and ranked according to the implementation from both Managerial and Operational level perspectives based on their means as illustrated in table 5.1.

Table 5.1 - Means of TQM elements implementation from Managerial and Operational level perspectives

Implementation of TQM elements (Managerial)	Mean	Implementation of TQM elements (operational)	Mean
Leadership	4.101	Leadership	3.872
Policy and Strategy	4.060		
Continuous Improvement	3.825	Continuous Improvement	3.554
Measurement and Feedback	4.019	Measurement and Feedback	3.845
Subcontractors and Suppliers Quality Management	4.010	Subcontractors and Suppliers Quality Management	3.837
Processes management	4.310	Processes Management	3.837
		Resources Management	3.628
		Education and Training	3.291
		Work Environment and Culture	3.806

Means implementation of TQM elements for both managerial and operational levels were graphed as shown in figure 5.1 and 5.2.

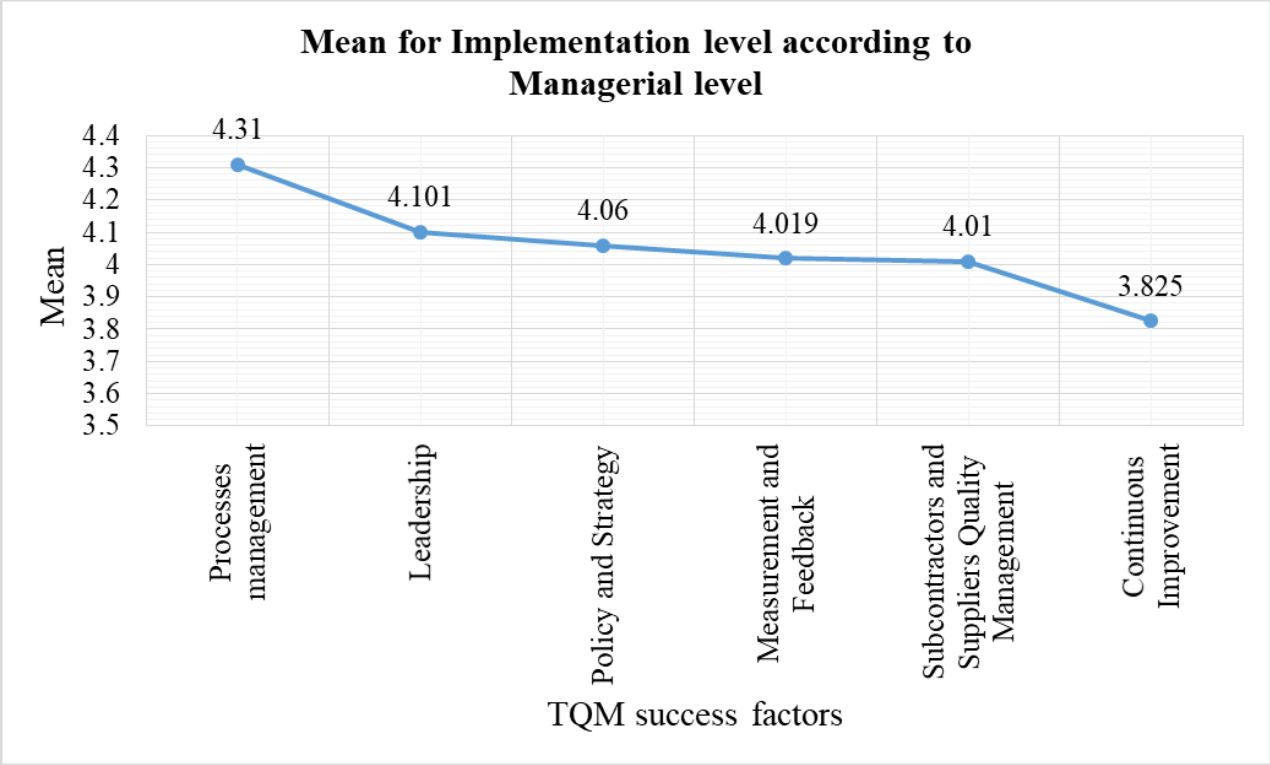


Figure 5.1
Chart of Mean for Implementation level according to Managerial level

From the Managerial level means graph, the Leadership factor registered the first drop on means line with mean value of 4.101. While, in Operational level means graph, the Resource Management factor recorded the first drop point on means line with mean value 3.628, despite this factor was not assessed from the managerial level respondents. The next point was Continuous Improvement that was selected since it is common between both levels and has a big drop in Managerial means graph as well.

Therefore, **Leadership** and **Continuous Improvement** factors were tested in the next stage along with the top ten critical success factors.

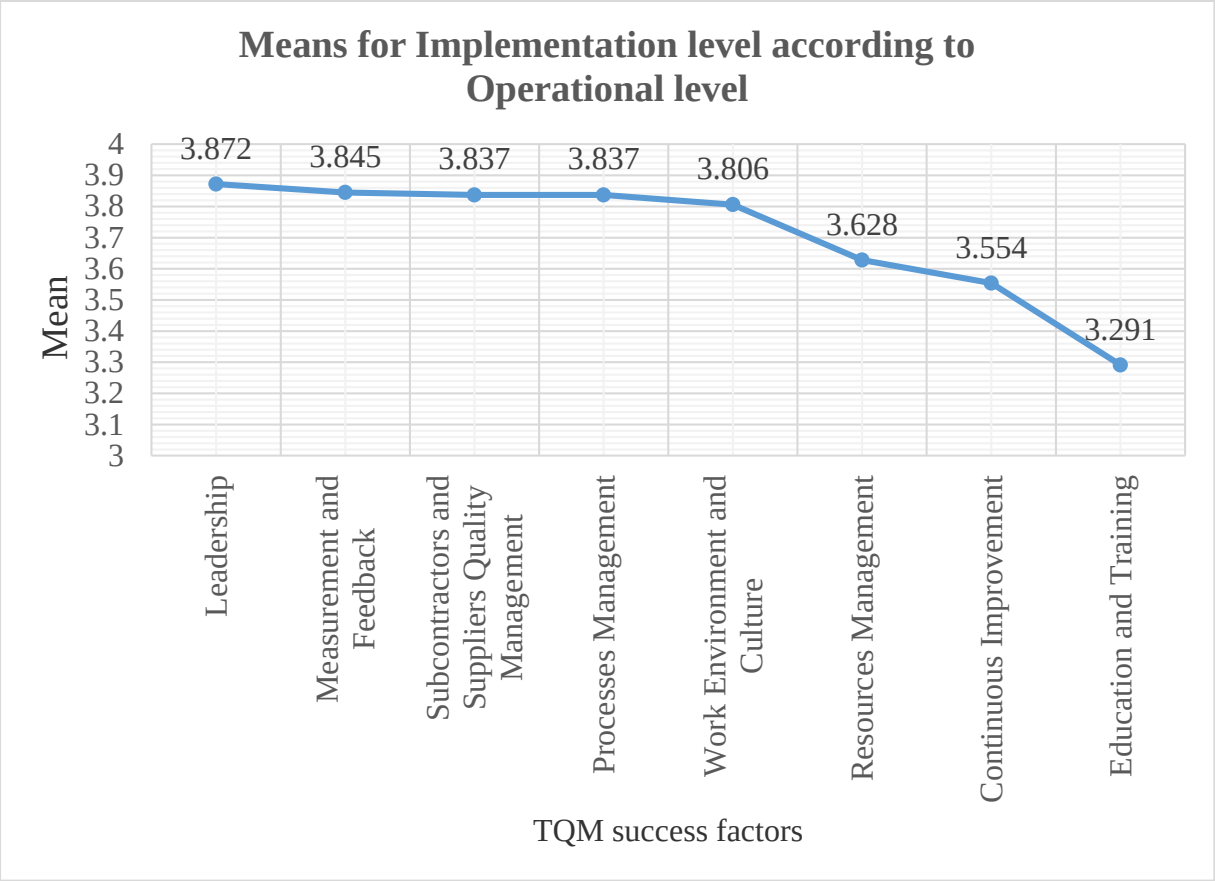


Figure 5.2
Chart of Mean of Implementation level according to Operational level

5.2.2.1 Questionnaires

To satisfy the objectives of the study, a complementary questionnaire was needed to provide weights to the top ten critical success factors comparatively to the selected TQM elements, leadership and continuous improvement, in order to get 100% or 70% or 50% or 20% achievement level of those TQM elements each.

The results of this questionnaire will be the output for the forecasting model and the percentages 100%, 70%, 50% and 20% are the level of output to be expected.

5.3 Questionnaire Design and Development

5.3.1 Target Audience

This questionnaire was targeting managers and engineers from Grade AA and Grade A of building contractors in Bahrain.

5.3.2 Questionnaire design

The questionnaire comprises of two sections, leadership and continuous improvement (Appendix E). Each section aims to measure the listed critical success factors in order of importance against TQM elements in the level of 20%, 50%, 70and and 100% level of implementation.

5.3.3 Data Measurement

A Likert five-point scale was used in the form of importance scale, in order to identify the importance of each critical success factor; namely Leadership and Continuous improvement.

5.3.4 Questionnaire Distribution

The questionnaire was distributed to the respondents using a web link created by surveymonkey.com online website, and the direct link was shared with the targeted sample by email.

5.3.5 Population

As mentioned earlier in chapter 4, building construction contractors from Grade AA and Grade A were selected to represent the population of this study.

5.3.6 Sample Size Determination

Sample size was explained and calculated earlier in chapter 4. Therefore, 67 building contractors out of the total population size, 80 building contractors grade A and AA in Bahrain, were targeted.

5.4 Questionnaire Results

A total of 101 responses, from managers and engineers from Grade AA and Grade A of building contractors, were received. The results are shown below.

5.4.1 Leadership

a. Table 5.2 presents the weight of Critical Success Factors comparatively to Leadership in order to get a 100% achievement level.
b. Table 5.3 presents the weight of Critical Success Factors comparatively to Leadership in order to get a 70% achievement level.
c. Table 5.4 presents the weight of Critical Success Factors comparatively to Leadership in order to get a 50% achievement level.
d. Table 5.5 presents the weight of Critical Success Factors comparatively to Leadership in order to get a 20% achievement level.

Table 5.2 Weight of Critical Success Factors comparatively to Leadership in order to get a 100% achievement level

	1	2	3	4	5	TOTAL	WEIGHTED AVERAGE
1. Top management's commitment and leadership	0.99% 1	0.99% 1	4.95% 5	16.83% 17	76.24% 77	101	4.66
2. Understanding of client's requirements and expectations of the project outcome	0.99% 1	1.98% 2	4.95% 5	23.76% 24	68.32% 69	101	4.56
3. Planning realistically for time, budget, material and human resources	0.99% 1	0.00% 0	3.96% 4	47.52% 48	47.52% 48	101	4.41
4. Quality education and training	0.99% 1	0.00% 0	6.93% 7	52.48% 53	39.60% 40	101	4.30
5. Teamwork	0.99% 1	0.00% 0	0.00% 0	39.60% 40	59.41% 60	101	4.56
6. Communication between top managers and employees	0.99% 1	0.99% 1	7.92% 8	24.75% 25	65.35% 66	101	4.52
7. Measuring customer satisfaction periodically	0.99% 1	1.98% 2	10.89% 11	37.62% 38	48.51% 49	101	4.31
8. Process management	0.99% 1	0.99% 1	6.93% 7	43.56% 44	47.52% 48	101	4.36
9. Time management	0.99% 1	2.97% 3	2.97% 3	35.64% 36	57.43% 58	101	4.46
10. Organizational culture (Shared beliefs and values established by leaders that ultimately shaping employee perceptions, behaviors and understanding).	0.99% 1	1.98% 2	11.88% 12	43.56% 44	41.58% 42	101	4.23

Table 5.3 Weight of Critical Success Factors comparatively to Leadership in order to get a 70% achievement level

	1	2	3	4	5	TOTAL	WEIGHTED AVERAGE
1. Top management's commitment	1.10% 1	0.00% 0	15.38% 14	72.53% 66	10.99% 10	91	3.92
2. Understanding of client's requirements and expectations of the project outcome	2.20% 2	3.30% 3	23.08% 21	57.14% 52	14.29% 13	91	3.78
3. Planning realistically for time, budget, material and human resources	1.10% 1	1.10% 1	32.97% 30	46.15% 42	18.68% 17	91	3.80
4. Quality education and training	1.10% 1	4.40% 4	35.16% 32	47.25% 43	12.09% 11	91	3.65
5. Teamwork	1.10% 1	2.20% 2	32.97% 30	50.55% 46	13.19% 12	91	3.73
6. Communication between top managers and employees	1.10% 1	3.30% 3	26.37% 24	34.07% 31	35.16% 32	91	3.99
7. Measuring customer satisfaction periodically	1.10% 1	5.49% 5	24.18% 22	52.75% 48	16.48% 15	91	3.78
8. Process management	3.30% 3	3.30% 3	21.98% 20	57.14% 52	14.29% 13	91	3.76
9. Time management	2.20% 2	1.10% 1	24.18% 22	54.95% 50	17.58% 16	91	3.85
10. Organizational culture	1.10% 1	7.69% 7	30.77% 28	51.65% 47	8.79% 8	91	3.59

Table 5.4 Weight of Critical Success Factors comparatively to Leadership order to get a 50% achievement level

	1	2	3	4	5	TOTAL	WEIGHTED AVERAGE
1. Top management's commitment	1.14% 1	7.95% 7	72.73% 64	10.23% 9	7.95% 7	88	3.16
2. Understanding of client's requirements and expectations of the project outcome	2.27% 2	10.23% 9	71.59% 63	6.82% 6	9.09% 8	88	3.10
3. Planning realistically for time, budget, material and human resources	1.14% 1	17.05% 15	60.23% 53	14.77% 13	6.82% 6	88	3.09
4. Quality education and training	1.14% 1	27.27% 24	55.68% 49	10.23% 9	5.68% 5	88	2.92
5. Teamwork	2.27% 2	23.86% 21	47.73% 42	20.45% 18	5.68% 5	88	3.03
6. Communication between top managers and employees	2.27% 2	28.41% 25	32.95% 29	25.00% 22	11.36% 10	88	3.15
7. Measuring customer satisfaction periodically	6.82% 6	26.14% 23	47.73% 42	12.50% 11	6.82% 6	88	2.86
8. Process management	1.14% 1	26.14% 23	53.41% 47	13.64% 12	5.68% 5	88	2.97
9. Time management	1.14% 1	25.00% 22	52.27% 46	13.64% 12	7.95% 7	88	3.02
10. Organizational culture	9.09% 8	26.14% 23	47.73% 42	11.36% 10	5.68% 5	88	2.78

Table 5.5 Weight of Critical Success Factors comparatively to Leadership in order to get a 20% achievement level

	1	2	3	4	5	TOTAL	WEIGHTED AVERAGE
1. Top management's commitment	35.29% 30	44.71% 38	10.59% 9	3.53% 3	5.88% 5	85	2.00
2. Understanding of client's requirements and expectations of the project outcome	49.41% 42	32.94% 28	8.24% 7	3.53% 3	5.88% 5	85	1.84
3. Planning realistically for time, budget, material and human resources	37.65% 32	42.35% 36	12.94% 11	2.35% 2	4.71% 4	85	1.94
4. Quality education and training	37.65% 32	47.06% 40	9.41% 8	2.35% 2	3.53% 3	85	1.87
5. Teamwork	38.82% 33	41.18% 35	12.94% 11	3.53% 3	3.53% 3	85	1.92
6. Communication between top managers and employees	38.82% 33	28.24% 24	18.82% 16	9.41% 8	4.71% 4	85	2.13
7. Measuring customer satisfaction periodically	48.24% 41	30.59% 26	8.24% 7	7.06% 6	5.88% 5	85	1.92
8. Process management	37.65% 32	44.71% 38	9.41% 8	5.88% 5	2.35% 2	85	1.91
9. Time management	36.47% 31	41.18% 35	12.94% 11	5.88% 5	3.53% 3	85	1.99
10. Organizational culture	42.35% 36	37.65% 32	15.29% 13	1.18% 1	3.53% 3	85	1.86

5.4.2 Continuous Improvement

a. Table 5.6 presents the weight of Critical Success Factors comparatively to Continuous Improvement p in order to get a 100% achievement level.
b. Table 5.7 presents the weight of Critical Success Factors comparatively to Continuous Improvement p in order to get a 70% achievement level.
c. Table 5.8 presents the weight of Critical Success Factors comparatively to Continuous Improvement p in order to get a 50% achievement level.
d. Table 5.9 presents the weight of Critical Success Factors comparatively to Continuous Improvement p in order to get a 20% achievement level.

Table 5.6 Weight of Critical Success Factors comparatively to Continuous Improvement in order to get a 100% achievement level

	1	2	3	4	5	TOTAL	WEIGHTED AVERAGE
1. Top management's commitment	3.57% 3	1.19% 1	1.19% 1	16.67% 14	77.38% 65	84	4.63
2. Understanding of client's requirements and expectations of the project outcome	2.38% 2	2.38% 2	4.76% 4	33.33% 28	57.14% 48	84	4.40
3. Planning realistically for time, budget, material and human resources	2.38% 2	1.19% 1	4.76% 4	39.29% 33	52.38% 44	84	4.38
4. Quality education and training	2.38% 2	1.19% 1	8.33% 7	33.33% 28	54.76% 46	84	4.37
5. Teamwork	2.38% 2	0.00% 0	5.95% 5	25.00% 21	66.67% 56	84	4.54
6. Communication between top managers and employees	2.38% 2	0.00% 0	1.19% 1	25.00% 21	71.43% 60	84	4.63
7. Measuring customer satisfaction periodically	2.38% 2	1.19% 1	4.76% 4	23.81% 20	67.86% 57	84	4.54
8. Process management	1.19% 1	3.57% 3	3.57% 3	30.95% 26	60.71% 51	84	4.46
9. Time management	1.19% 1	4.76% 4	4.76% 4	32.14% 27	57.14% 48	84	4.39
10. Organizational culture	3.57% 3	2.38% 2	10.71% 9	34.52% 29	48.81% 41	84	4.23

Table 5.7 Weight of Critical Success Factors comparatively to Continuous Improvement in order to get a 70% achievement level

	1	2	3	4	5	TOTAL	WEIGHTED AVERAGE
1. Top management's commitment	1.23% 1	1.23% 1	20.99% 17	65.43% 53	11.11% 9	81	3.84
2. Understanding of client's requirements and expectations of the project outcome	1.23% 1	3.70% 3	32.10% 26	51.85% 42	11.11% 9	81	3.68
3. Planning realistically for time, budget, material and human resources	2.47% 2	1.23% 1	39.51% 32	48.15% 39	8.64% 7	81	3.59
4. Quality education and training	3.70% 3	2.47% 2	28.40% 23	58.02% 47	7.41% 6	81	3.63
5. Teamwork	2.47% 2	3.70% 3	22.22% 18	59.26% 48	12.35% 10	81	3.75
6. Communication between top managers and employees	1.23% 1	2.47% 2	33.33% 27	40.74% 33	22.22% 18	81	3.80
7. Measuring customer satisfaction periodically	1.23% 1	2.47% 2	30.86% 25	55.56% 45	9.88% 8	81	3.70
8. Process management	1.23% 1	4.94% 4	23.46% 19	58.02% 47	12.35% 10	81	3.75
9. Time management	2.47% 2	4.94% 4	20.99% 17	58.02% 47	13.58% 11	81	3.75
10. Organizational culture	1.23% 1	9.88% 8	23.46% 19	58.02% 47	7.41% 6	81	3.60

Table 5.8 Weight of Critical Success Factors comparatively to Continuous Improvement in order to get a 50% achievement level

	1	2	3	4	5	TOTAL	WEIGHTED AVERAGE
1. Top management's commitment	1.23% 1	8.64% 7	72.84% 59	9.88% 8	7.41% 6	81	3.14
2. Understanding of client's requirements and expectations of the project outcome	2.47% 2	14.81% 12	62.96% 51	11.11% 9	8.64% 7	81	3.09
3. Planning realistically for time, budget, material and human resources	1.23% 1	28.40% 23	55.56% 45	11.11% 9	3.70% 3	81	2.88
4. Quality education and training	2.47% 2	24.69% 20	56.79% 46	11.11% 9	4.94% 4	81	2.91
5. Teamwork	2.47% 2	23.46% 19	59.26% 48	9.88% 8	4.94% 4	81	2.91
6. Communication between top managers and employees	2.47% 2	33.33% 27	33.33% 27	17.28% 14	13.58% 11	81	3.06
7. Measuring customer satisfaction periodically	4.94% 4	30.86% 25	48.15% 39	8.64% 7	7.41% 6	81	2.83
8. Process management	2.47% 2	30.86% 25	50.62% 41	9.88% 8	6.17% 5	81	2.86
9. Time management	2.47% 2	32.10% 26	49.38% 40	9.88% 8	6.17% 5	81	2.85
10. Organizational culture	8.64% 7	23.46% 19	54.32% 44	8.64% 7	4.94% 4	81	2.78

Table 5.9 Weight of Critical Success Factors comparatively to Continuous Improvement in order to get a 20% achievement level

	1	2	3	4	5	TOTAL	WEIGHTED AVERAGE
1. Top management's commitment	40.74% 33	44.44% 36	3.70% 3	4.94% 4	6.17% 5	81	1.91
2. Understanding of client's requirements and expectations of the project outcome	48.15% 39	32.10% 26	8.64% 7	3.70% 3	7.41% 6	81	1.90
3. Planning realistically for time, budget, material and human resources	40.74% 33	35.80% 29	13.58% 11	4.94% 4	4.94% 4	81	1.98
4. Quality education and training	37.04% 30	44.44% 36	6.17% 5	7.41% 6	4.94% 4	81	1.99
5. Teamwork	34.57% 28	44.44% 36	12.35% 10	3.70% 3	4.94% 4	81	2.00
6. Communication between top managers and employees	39.51% 32	35.80% 29	9.88% 8	8.64% 7	6.17% 5	81	2.06
7. Measuring customer satisfaction periodically	46.91% 38	29.63% 24	12.35% 10	4.94% 4	6.17% 5	81	1.94
8. Process management	45.68% 37	30.86% 25	13.58% 11	4.94% 4	4.94% 4	81	1.93
9. Time management	40.74% 33	39.51% 32	11.11% 9	2.47% 2	6.17% 5	81	1.94
10. Organizational culture	49.38% 40	32.10% 26	13.58% 11	0.00% 0	4.94% 4	81	1.79

5.5 Chapter Summary

The aim of the data collection for this part of the research is to choose the most applicable data from the previous questionnaire and use it to gather the data needed to produce the effective forecasting model of TQM implementation.

A questionnaire conducted to test two factors, *Leadership* and *Continuous Improvement* along with the top ten critical success factors in order of importance, against TQM elements in the level of 20%, 50%, 70% and 100% level of implementation. 67 building contractors out of the total population size, 80 building contractors grade A and AA in Bahrain, were targeted.

The results of the questionnaire used as an input data to formulate the Input Code that will be used on the software to generate the TQM implementation forecasting model.

CHAPTER 6
Modeling with Regression

6.1 Introduction

6.2 Regression Analysis

6.3 Gaussian Regression

6.4 Model Building

6.5 Model Training and Validation

6.6 Summary of Results

6.7 Chapter Summary

Chapter 6
Modeling with Regression

6.1 Introduction

This chapter provides an overview of the type of regression applied by this study, as well as it explains the Mean Absolute Error, the Root Mean Square Error, Coefficient of determination, and Gaussian Regression.

In addition, introduces the forecast of Models for the effective implementation of TQM in the construction of Mega building projects. Several algorithms can be used for the prediction, Regression is chosen to identify which can predict the most suitable and reliable model for the application of TQM. However, for validating the model, a plentiful trial and error process was executed to obtain the best forecasting model structure.

Further explanation for the process followed to design the forecasting model and the software used are in presented in the sections below.

6.2 Regression Analysis

For the purpose of modeling and conducting analysis for numerous variables, several techniques exist, among them, regression analysis is one. Regression Analysis (RA) “refers to a group of factual devices that can help from numerous points of view to anticipate things of different segments” (Baseer et al., 2019). Regression analysis is deployed to examine the relationship between two variables. “The response variable y is the dependent variable or variable of interest, and the predictor variable x is the independent variable. An objective of regression analysis is to develop a regression

model, relating y to x that can be used to predict values of the response variable" (Mishra et al., 2016). Goodness of fit is essential in model building, but it is not always important, or even applied, for all types of regression analyses. "As a rule of thumb one may say that goodness of fit is important when the model is focused (model orientation), but less important when we focus on single effects (factor orientation)" (Hagquist and Stenbeck, 1998).

Based on this premise, "Multiple-linear regression is a predictive analysis approach of representing data and relationship that exists between one dependent and two or more independent variables that use statistic solutions. The goal of multiple linear regression (MLR) is to model the relationship between the explanatory and response variables" (Egbe et al., 2016). In case, there is more than one regressor, it is known as multi variable regression. As a rule, the reaction variable y might be identified with k regressors, x1, x2,… ,xk, so that $y = \beta0 + \beta1x1 + \beta2x2 +\ldots+ \beta kxk + \varepsilon$ (Baseer et al., 2019).

6.2.1 Mean Absolute Error

The relative mean absolute error (or relative MAE) *is defined* as "the average of the absolute values of the prediction errors from one model, divided by the average of the absolute values of the prediction errors from a second model" (Hyndman and Koehler 2006). calculated for the data set as:

$$\mathrm{MAE} = \frac{1}{n}\sum_{i=1}^{n}|e_i|$$

6.2.2 Mean Absolute Percentage Error

The mean absolute percentage error (MAPE) is one of the most common measures of the forecast accuracy. MAPE is described as "the average of absolute percentage

errors (APE) (Kim and Kim, 2016). Let At and Ft denote the actual and forecast values at data point t, respectively. MAPE is defined as:

$$\text{MAPE} = \frac{1}{N}\sum_{t=1}^{N}\left|\frac{A_t - F_t}{A_t}\right|, \qquad (1.1)$$

6.2.3 Root Mean Square Error

The root mean square error (RMSE) has been used as a standard statistical metric, to measure model performance in meteorology (Chai and Draxler, 2014). It is calculated for the data set as:

$$\text{RMSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n} e_i^2}.$$

6.2.4 Coefficient of determination

The coefficient of determination, also known as R2 , is perhaps the most common measure of goodness of fit for linear models (LM) (Draper and Smith, 1998). It is defined as the proportion of the corrected sum of squares that is explained by the model (Piepho, 2018).

6.3 Gaussian Regression

Gaussian processes are a far flexible approach to regression. Instead of the assumption that the relations between the criterion variable y and the predictor

variable x is in a linear form f(x), (e.g., y = 1 + x + x 2 + x 3). The Gaussian approach consents for a non-parametric approach, where the correlations in the data are expressed by the selection of mean function and kernel “covariance function” (Blomqvist, 2018).

Gaussian processes are thus considered a generic method for controlled learning deployed, for both regression and categorization. Gaussian processes consider as a prevailing and flexible framework to conduct Bayesian inference (Stein, 2012; and Robert, 2014). In a Gaussian process viewpoint, we can distribute the parametric model (Bayesian linear regression), and instead of placing priors on the loads, prior probabilities are clearly defined over the functions directly, i.e., executing inference on “the function space instead of on the weigh space” (Bishop, 2006). Rasmussen and Williams (2006), define a Gaussian process as:

“An assembly of variables selected randomly, any confined number that has a joint Gaussian distribution (Blomqvist, 2018). A Gaussian process is thus a group of random variables, and these random variables are in this case the function g(x) as the aim is to acquire more knowledge about the positions x. Gaussian processes are wholly identified by their second-order statistics, i.e., the two functions: (1) the

$$\mu(\mathbf{x}) = \mathbb{E}[g(\mathbf{x})]$$

mean function μ,

$$k(\mathbf{x}, \mathbf{x}') = \mathrm{Cov}[g(\mathbf{x}), g(\mathbf{x}')] = \mathbb{E}[\big(g(\mathbf{x}) - \mu(\mathbf{x})\big)\big(g(\mathbf{x}') - \mu(\mathbf{x}')\big)].$$

and (2) the covariance function k (often called the kernel),

In controlled learning approaches, it is frequently supposed that input data x that are positioned close to each other are probable having similar responses y. The mean function articulates the tenets about the anticipated values of the random variable g(x) and in the covariance function it is identified how to select to define the similarity of the function values of g(x) at data points x and x. (Bishop, 2006; Rasmussen, 2004).

Gaussian processes and models equivalent to Gaussian processes have been expansively tested in numerous domains. For instance, "the Kalman filter (1960), radial basis function networks (Broomhead and Lowe, 1988) (an artificial neural network using radial basis activation functions) and ARMA (Tiao and Box, 1981) (autoregressive moving average) models, can all be seen as forms of Gaussian processes. Also, in geostatistics Gaussian processes regression is known as Kriging (Cressie, 1993)" (Blomqvist, 2018).

Provided a group of training data, a GP describes a multivariate Gaussian distribution over all the functions that fit such data. In other meaning, the GP yields any arbitrary group of inputs expresses a joint normal distribution. The mathematical form of a GP is defined in (Eq. 1). **x** and **x**' are two different input vectors (of arbitrary dimension) m(x) is a mean function (Eq. 2), defined as the expected value of the GP, and k(x,x') is a covariance function (or kernel) (Eq. 3), capturing the correlation among different input sets reflecting it in the output".

$$f(\mathbf{x}) \sim \mathcal{GP}(m(\mathbf{x}), k(\mathbf{x}, \mathbf{x}')) \tag{1}$$

$$m(\mathbf{x}) = \mathbb{E}\left[f(\mathbf{x})\right] \tag{2}$$

$$k(\mathbf{x}, \mathbf{x}') = \mathbb{E}\left[\left(f(\mathbf{x}) - m(\mathbf{x})\right)\left(f(\mathbf{x}') - m(\mathbf{x}')\right)\right] \tag{3}$$

The beginning point of the fitting procedure is the definition of a prior distribution, that will be transformed into a subsequent based on the observed data (in a Bayesian approach). Generally, a zero mean function is given for the prior, as this has a insignificant impact on the subsequent. The construct of the output functions - with specific orientation to its smoothness - is ruled by the covariance function, which requires the covariance between pairs of variables that were selected randomly. Thus, “the nature of the covariance function is the main input from the user and should reflect the expected behavior of the output”. A prevalent choice in engineering applications “is the squared exponential covariance” (Eq. 4), that reflects the “stability” of the “elaborated physical quantities (i.e., a small perturbation of the input produces small changes in the output) In such equation”, (xi − x' i) is the distance between two input σ_i^2 sets, represent the length scale of the output in each input dimension. σ_f^2 is the signal variance, which can be σ_f^2 seen as the variance of single observations (i.e. the covariance function is equal to when the distance between x and x' is zero). The parameters of the covariance are known as hyperparameters as those are not determined by the user but learnt from the data (GPs are non-parametric models) (Gentile and Galasso, 2019).

$$k(\mathbf{x},\mathbf{x}') = \sigma_f^2 \exp\left(-\frac{1}{2}\sum_i \frac{(x_i - x_i')^2}{\sigma_i^2}\right) \qquad (4)$$

The subsequent integrates in the GP the knowledge implied in the training data. "Specifically, this is acquired by conditioning the joint prior distribution (Eq. 5), to the observed data. Equations 6,7 and 8 depict this by postulating a vector of (known) training outputs y, for which each component is related to a vector of inputs. The

column vector inputs are collected in the X matrix. The pairs are related to the (unknown) “test data is the noise variance, which is a hyper parameter that reflects the uncertain nature of the training pairs” (Gentile and Galasso, 2019).

$$\begin{bmatrix} \mathbf{y} \\ \mathbf{f}_* \end{bmatrix} \sim \mathcal{N}\left(0, \begin{bmatrix} \mathbf{K}(\mathbf{X},\mathbf{X}) + \sigma_n^2\mathbf{I} & \mathbf{K}(\mathbf{X},\mathbf{X}_*) \\ \mathbf{K}(\mathbf{X}_*,\mathbf{X}) & \mathbf{K}(\mathbf{X}_*,\mathbf{X}_*) \end{bmatrix}\right) \tag{5}$$

$$\mathbf{f}_* \mid \mathbf{X},\mathbf{y},\mathbf{X}_* \sim \mathcal{N}(\bar{\mathbf{f}}_*, \mathrm{cov}(\mathbf{f}_*)) \tag{6}$$

$$\mathbf{f}_* = \mathbf{K}(\mathbf{X}_*,\mathbf{X})[\mathbf{K}(\mathbf{X},\mathbf{X}) + \sigma_n^2\mathbf{I}]^{-1}\mathbf{y} \tag{7}$$

$$\mathrm{cov}(\mathbf{f}_*) = \mathbf{K}(\mathbf{X}_*,\mathbf{X}_*) - \mathbf{K}(\mathbf{X}_*,\mathbf{X})[\mathbf{K}(\mathbf{X},\mathbf{X}) + \sigma_n^2\mathbf{I}]\mathbf{K}(\mathbf{X},\mathbf{X}_*) \tag{8}$$

The last step of the procedure is the identification of the hyper parameters. “This is performed by maximizing the likelihood, p(y | X,θ) , which is the probability of predicting the training data y, given the training input set X and a set of hyperparameters θ. This is carried out adopting numerical optimization algorithms often available by default in many programming languages” (Gentile and Galasso, 2019).

6.4 Model Building

The regression analysis was chosen to execute the forecasting model. The forecasting model is an improvement tool that help the contractors to predict the level of TQM implementation to assess and improve the process to ensure the effective and successful TQM implementation.

Regression analysis is a statistical process that is used to estimate the relationship among variables. Fitting a curve for a specific data while minimizing the total squared error and maximizing the goodness of fit (R^2) is the core idea of a

regression analysis. Regression models are used to describe a dependent variable by using the least number of parameters. Regression model is called multiple linear regression when it has linear coefficients and a multiple number of independent variables. In most of the studies where regression analysis is applied, more than one independent variable is needed as in this study.

6.4.1 Data Standardization and Organization

The preparation of the input data and statistical computations had been performed by applying Microsoft Excel. Before generating the Input Code, the data collected through the survey had gone through a cleaning data Process.

Data cleaning or data cleansing is process of detecting and removing errors and not useful information from original data, in order to improve the quality of data. It is necessary to generate accurate and consistent results. Some data quality problems occur because of many reasons, like misspellings during data entry, missing information, redundant data, or other invalid data. When data needed as a database for database system or web-based information systems, the need for data cleaning increases significantly (Rahm, 2000).

The processed data are entered to a Microsoft Excel spreadsheet to formulate the Code in the required manner that Matlab will accept as a database (Both Codes for Leadership and Continuous improvement are saved on a CD attached to the thesis report).

6.4.2 Software used to design Regression Model

Regression model can be developed using a wide variety of software packages. Microsoft Excel is a popular spreadsheet package, SAS, SCA, RATS, MATLAB, and EViews can do simple or multiple regressions. The regression models in this

study are developed using Gaussian Regression Toolbox by MATLAB. It is selected for its ease of use, speed of formulating, and flexibility of building and adjusting the Models.

MATLAB is a multi-numerical computing tool developed by MathWorks. It started developing in the late 1970 in the Computer Science Department at the University of New Mexico. The programme is built around the MATLAB scripting language and it is used by scientists, academics and wide range users across industry for numerical computing for various backgrounds including engineering in general and construction projects management in specific. MATLAB application practice comprises of working through Command Window as an interactive mathematical case or through performing text files comprising of MATLAB code (Matlab, 2017).

Each Regression model can be trained to perform a particular function by adjusting the validity ratio. In MATLAB there are several regression tools that help the user to perform any kind of regression model smoothly and easily such as using the "Regression Learner" Tool.

6.4.3 Network structure and Data Entry

Two forecasting models were developed using Regression Learner Toolbox by MATLAB, while the preparation of the input data and statistical computations had been performed by applying Microsoft Excel (Code).

MATLAB contains various algorithms to train and validate the forecasting model. To decide which algorithm to use, train multiple models then compare their validation errors to choose the best model.

Regression Learner is used to train regression models including linear regression models, regression trees, Gaussian process regression models, support vector

machines, and ensembles of regression trees. In addition to training models, other supportive functions are available like explore data, select features, specify validation schemes, and evaluate results. The model can be exported to the workspace to use it with new data or generate MATLAB code.

The workflow of training regression models in the Regression Learner application is shown in the below flowchart.



Figure 6.1

Flowchart of the training regression forecasting model workflow

The Regression Learner application displays the results of the validated model. Analytical measures, for example model accuracy and plots for example response plot or residuals plot reflect the validated model results. The application allows to automatically train one or more forecasting models, compare validation results, and choose the best forecasting model that works for your regression problem. The exported forecasting model will be used to make predictions on new data.

The steps describe the model formulating process is in the Appendix (Appendix F).

6.5 Model Training and Validation

The selected forecasting models consider to be an assessment tool to predict the output factor (dependent variables) in the form of implementation level, against the two TQM elements (Leadership and Continues Improvement) and (independent

variables). This tool will allow the contractor to know the performance level and areas that need to be improve. The objective of training the regression forecasting model is to get the ideal forecasting model that perform the best. To achieve that, number of models were tested and evaluated.

The evaluation approaches that have been used to test the forecasting models are:

1- Root Mean Square Error (RMSE)
2- Coefficient of Determination R-squared Values (R^2)
3- Mean Squared error (MSE)
4- Mean Absolute Error (MAE)

"In Gaussian process regression, the response is modeled using a probability distribution over a space of functions. The flexibility of the presets in the Model Type gallery is automatically chosen to give a small training error and, simultaneously, protection against overfitting" (MATLAB Help).

After applying the steps mentioned in appendix F, the optimum forecasting models for Leadership and continuous improvement were selected.

6.5.1 Leadership Forecasting model

95 iterations conducted to predict the model with both different validation ratio for every run as the following:

- Cross-validation: starting from 2 folds to 50 folds (49 iterations)
- Holdout validation: starting from 5% to 50% held out (46 iterations)

The best forecasting model chosen illustrated in the below figures.

Gaussian process regression (GPR) model, trained using the sample data from the code entered with Cross-validation = 10 folds.

Figure 6.2 present the data entry for the trained model with 10 cross-validation folds.

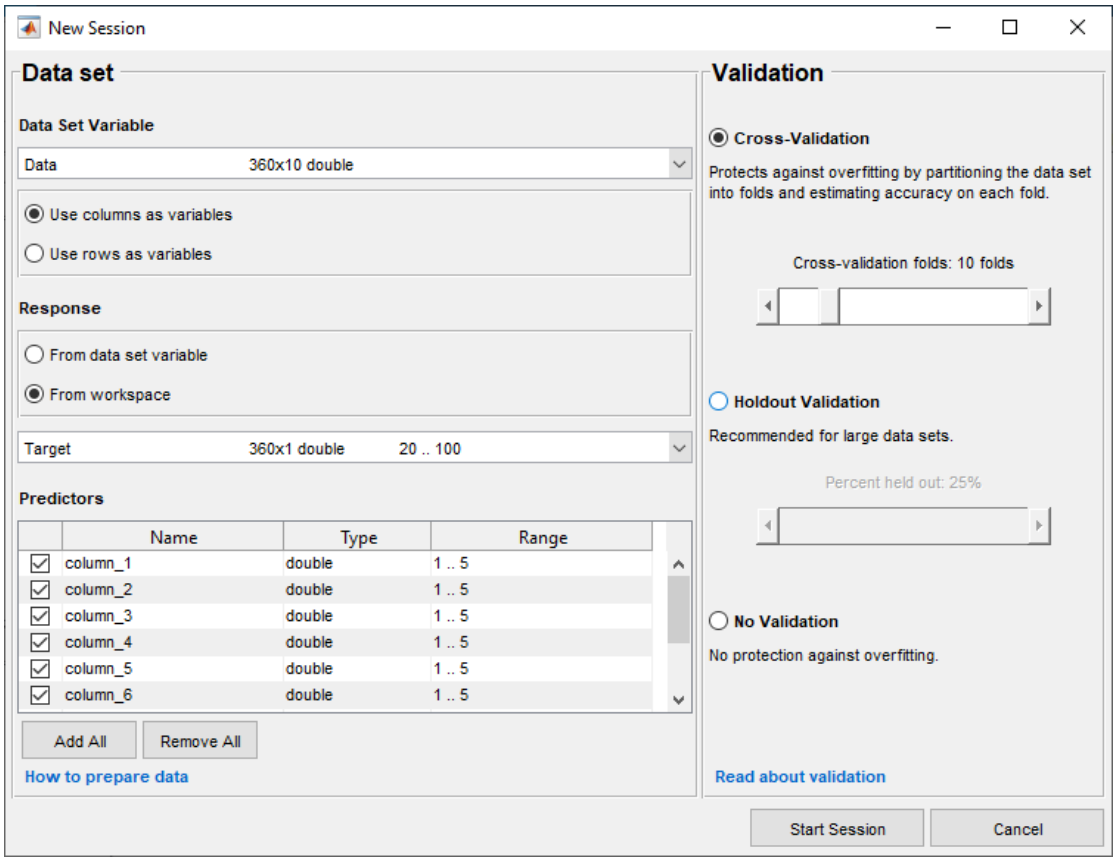


Figure 6.2

Data entry for the trained model with 10 cross-validation folds

Figure 7.3 illustrate the input original data, which is the survey responses. The graph showing the results of the survey, the entered data and the levels of implementation (100, 70, 50, 20%) as per the survey. This data will be trained and tested to generate the forecasting model.

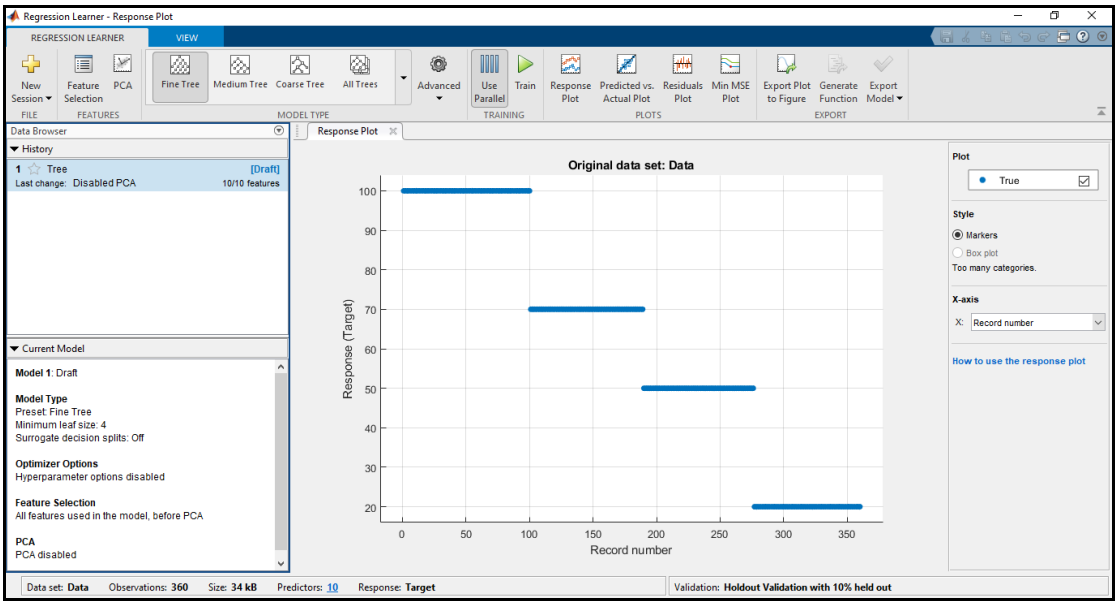


Figure 6.3

Response plot of the data

Figure 7.4 shows the app with a History list containing Gaussian regression model types.

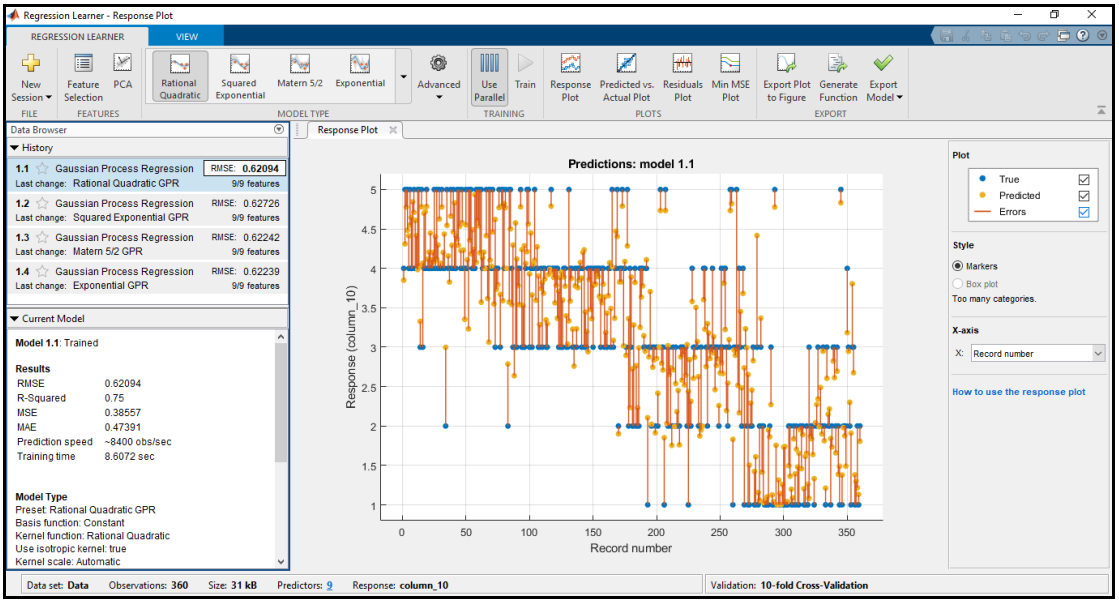


Figure 6.4

Visualize summary statistics

The history list in figure 6.5 shows the entire trained model using GPR tool and 10 cross-validation folds. The highlighted model is the best overall score. This score is the root mean square error (RMSE) on the validation set. All the performance indicators are listed in the Current model area.

The results of the testing samples are presented and compared using statistical performance parameters in order to choose the best forecasting model.

The illustrated results show that the **Rational Quadratic GPR model** give the best values among all iterations conducted.

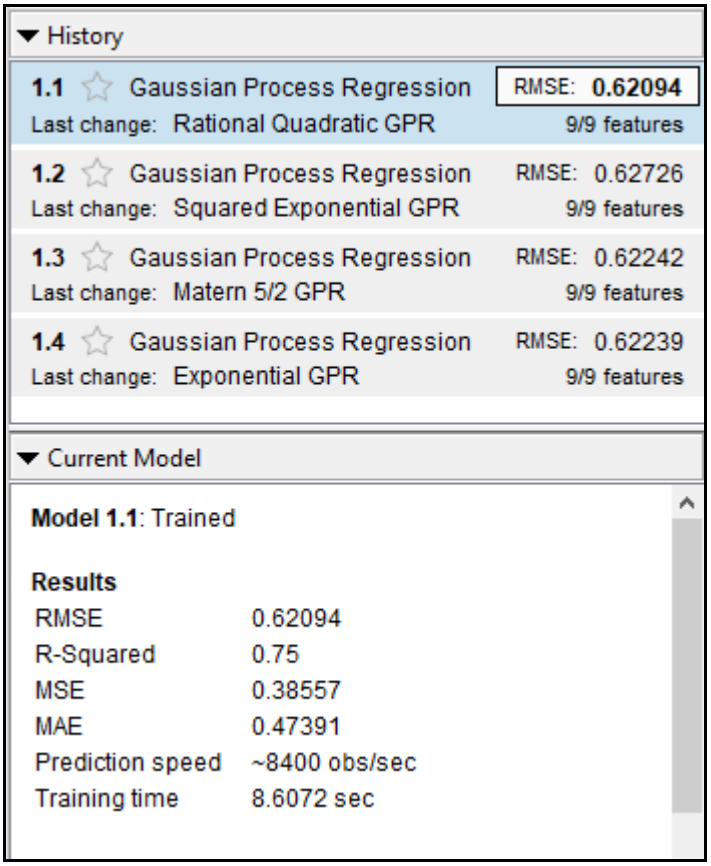


Figure 6.5

The History list show the models overall score.

This model is chosen to be the best, because it has better RMSE results with a higher difference reflecting a better performance as in figure 6.6. The calculation results for RMSE, R^2, MSE, and MAE of the test sample are shown in Table 6.1.

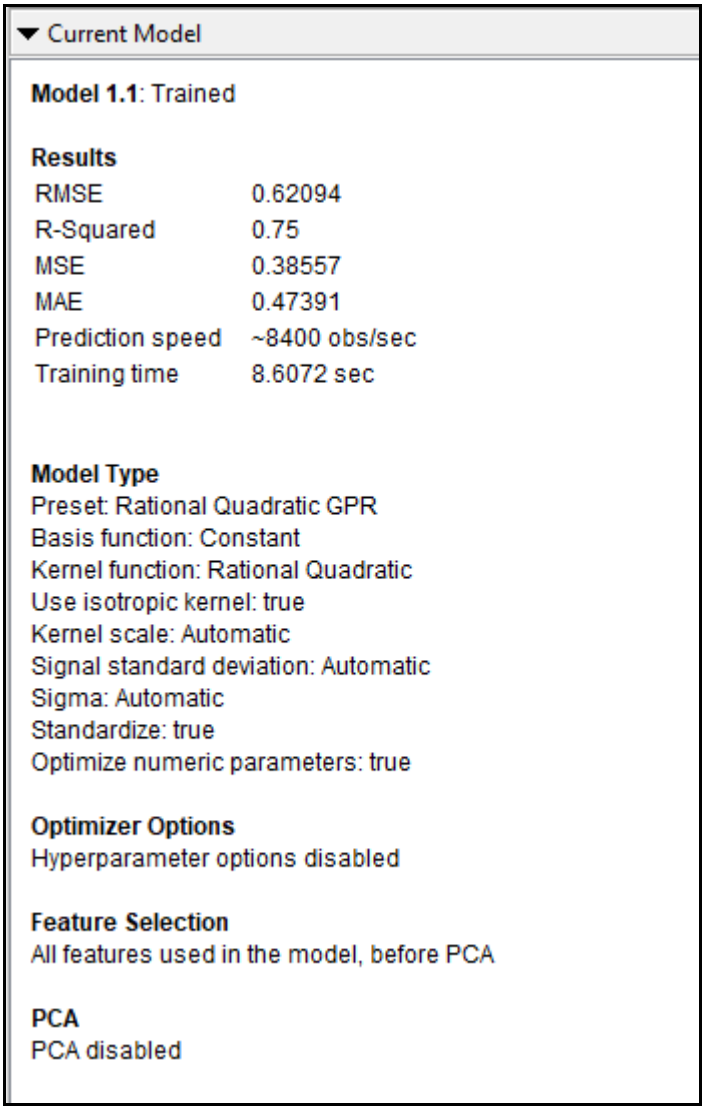


Figure 6.6

Model Statistics

Table 6.1 Performance of Test Sample Model for Leadership

Root Mean Square Error	(RMSE)	0.62094	Positive value - Small value
Coefficient of Determination	(R^2)	0.75	Smaller than one and larger then 0 Close to 1
Mean Squared error	(MSE)	0.38557	Small value
Mean Absolute Error	(MAE)	0.47391	Positive value - Small value

The goodness of fit for the regression forecasting model was based on 10 cross-validation folds using the full data set. The Root mean square error illustrate how far data points are from the regression line. The obtained value (0.62094) show that the data is highly concentrated around the line of best fit. The coefficient of determination show how many data points fall within the regression line. The obtained Coefficient value (0.75) means that 75% of the points plotted around the regression line. The higher value toward 1, the better goodness of fit. The mean squared error is representing the errors in the form of distances from the point to the regression line. The squaring is required to remove the negative sign if exist. The mean squared value in the model is 0.38557, which is a low value, indicating that indicates that the forecasting model is close to the line of best fit. Mean absolute error is the average of all absolute errors. It measures the errors between paired observations in the form of vertical or horizontal lines between points. The error computed in this model equaled 0.47391, which is consider a low value and thus best to fit.

The following figures represent the trained model performance results in Plots.

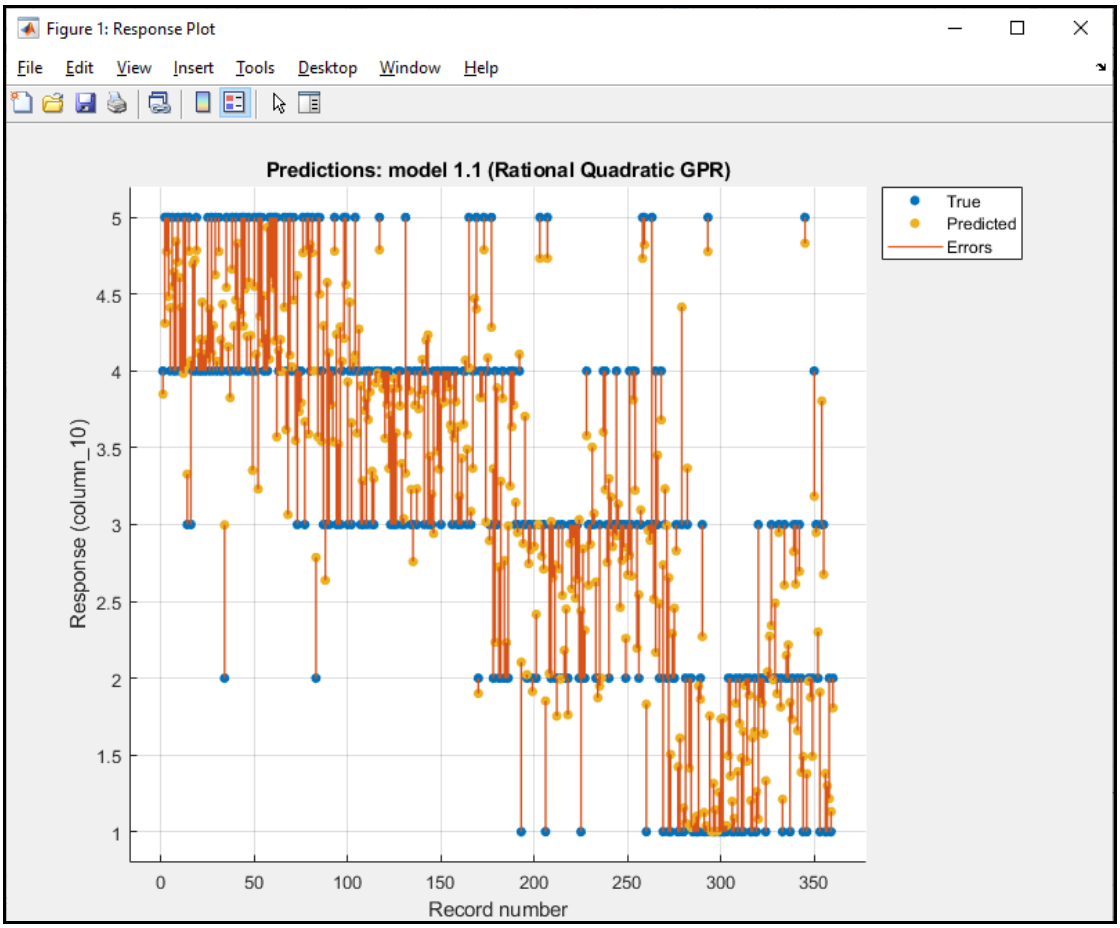


Figure 6.7 Response plot: Plot the actual versus predicted responses

Figure 6.7, the Response Plot show prediction errors presented as vertical lines between the predicted and true responses.

Figure 6.8, present the Predicted vs. Actual plot, that used to check model performance after training the model. The predicted responses of the model are plotted against the actual, true responses. The model has predicted responses equal to the true responses, so all the points lie on the regression line. The vertical distances from the line to any point is the error of the prediction for that point. The forecasting model is considered a good model since it has small errors, and predictions are scattered symmetrically around the diagonal line.

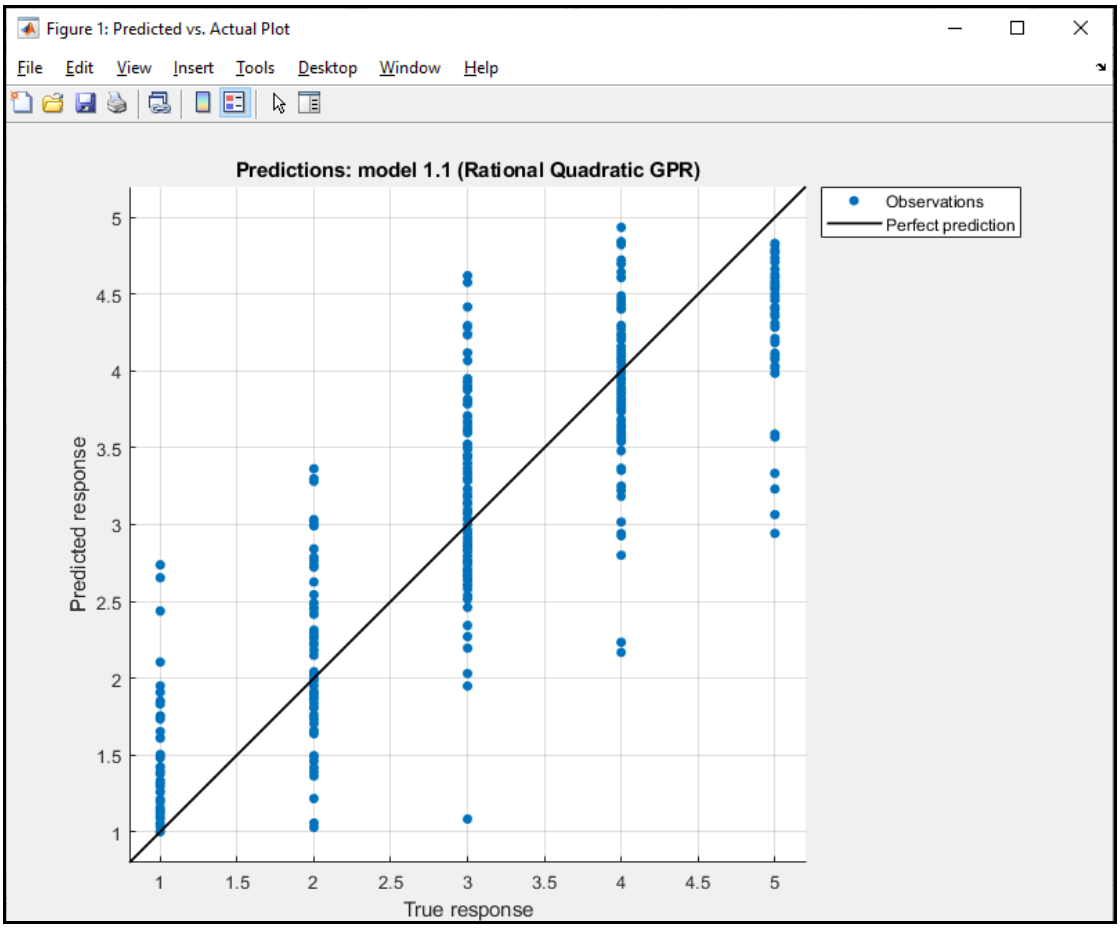


Figure 6.8

Plot Predicted vs. Actual Response

Figure 6.9, present the residuals plot that displays the difference between the predicted and true responses. The Forecasting model is considered a good model, since the residuals scattered roughly symmetrically around 0.

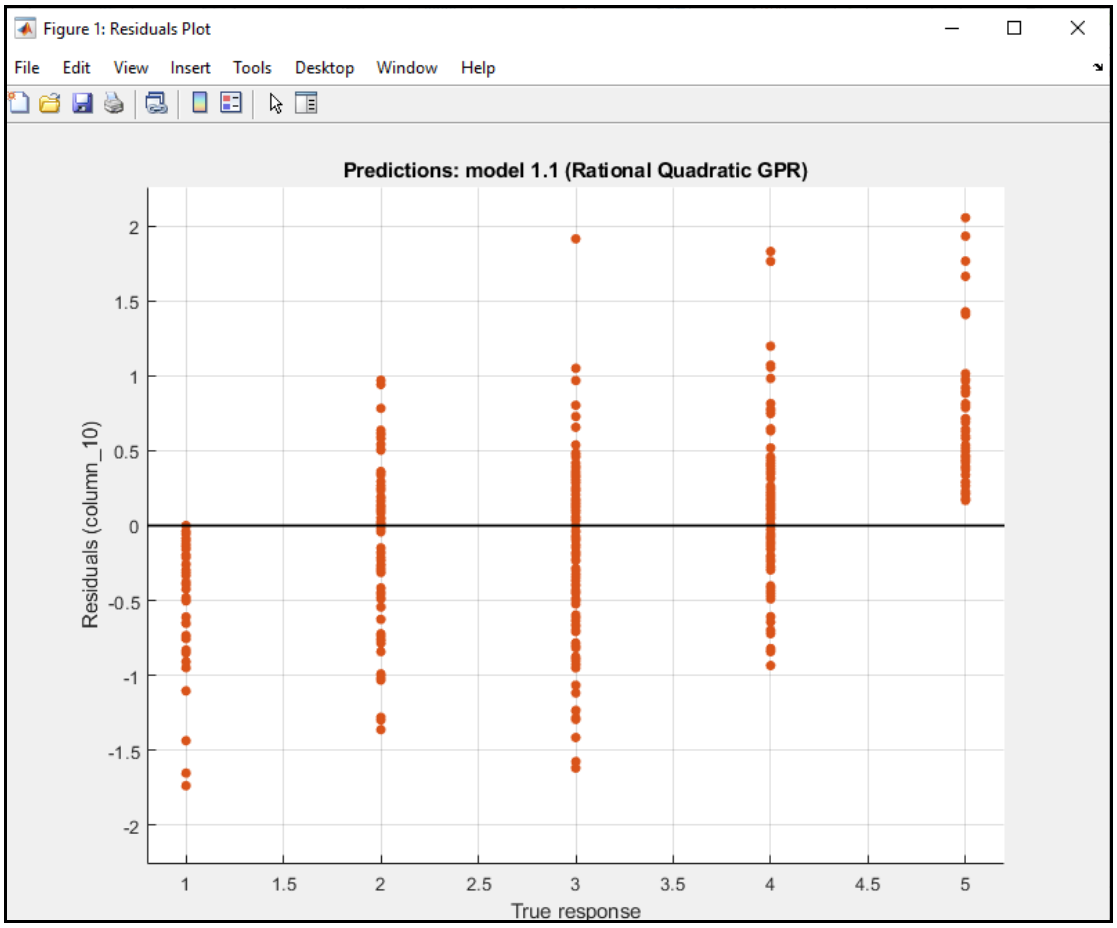


Figure 6.9

Residuals Plot

Figure 6.10; show the Box Plot chart that displays the typical values of the response and any possible outliers. The central mark indicates the median, and the bottom and top edges of the box are the 25th and 75th percentiles, respectively. Vertical lines, called whiskers, extend from the boxes to the most extreme data points that are not considered outliers.

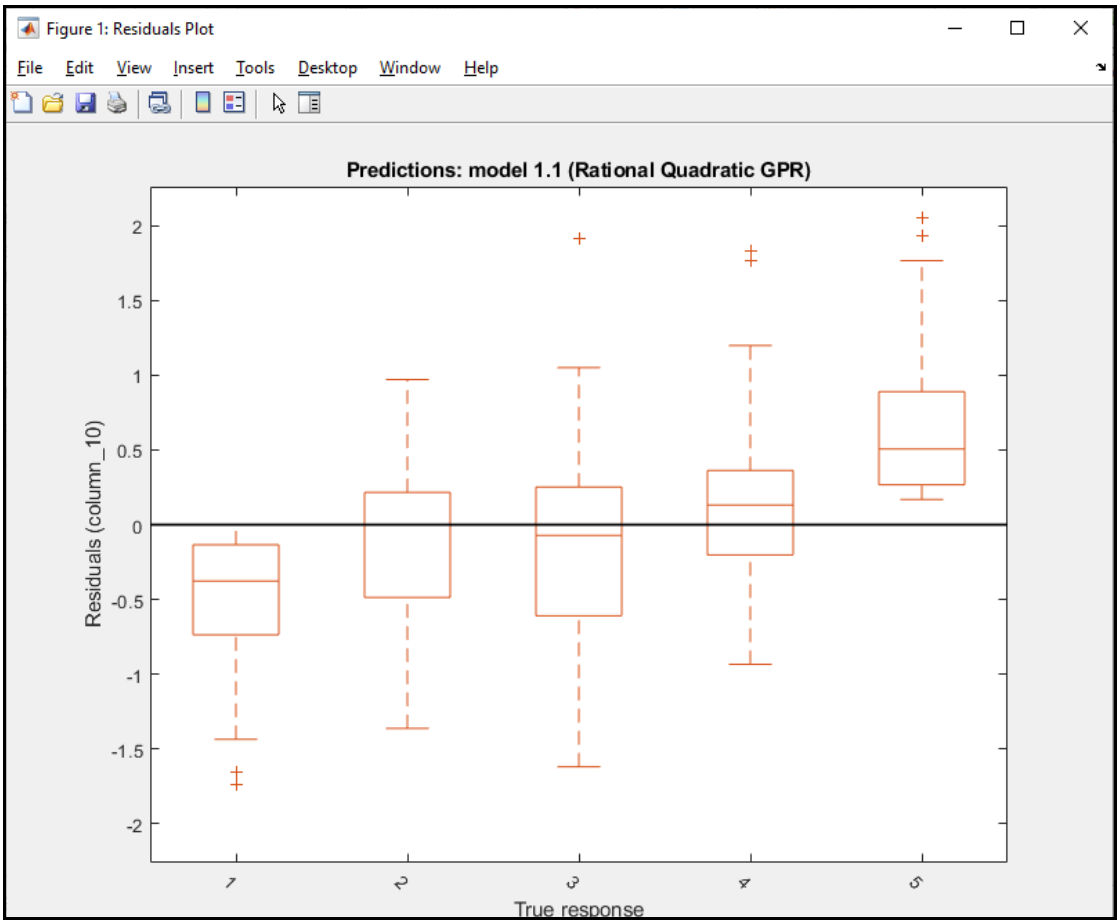


Figure 6.10

Box Chart plot

6.5.2 Continues Improvement forecasting model

95 iterations conducted to predict the forecasting model with both different validation ratio for every run as the following:

- Cross-validation: starting from 2 folds to 50 folds (49 iterations)
- Holdout validation: starting from 5% to 50% held out (46 iterations)

The best forecasting model chosen illustrated in the below figures.

Gaussian process regression (GPR) model, trained using the sample data from the code entered with Holdout validation 29 percent hold out.

Figure 6.11 present the data entry for the trained model with 29% Holdout validation.

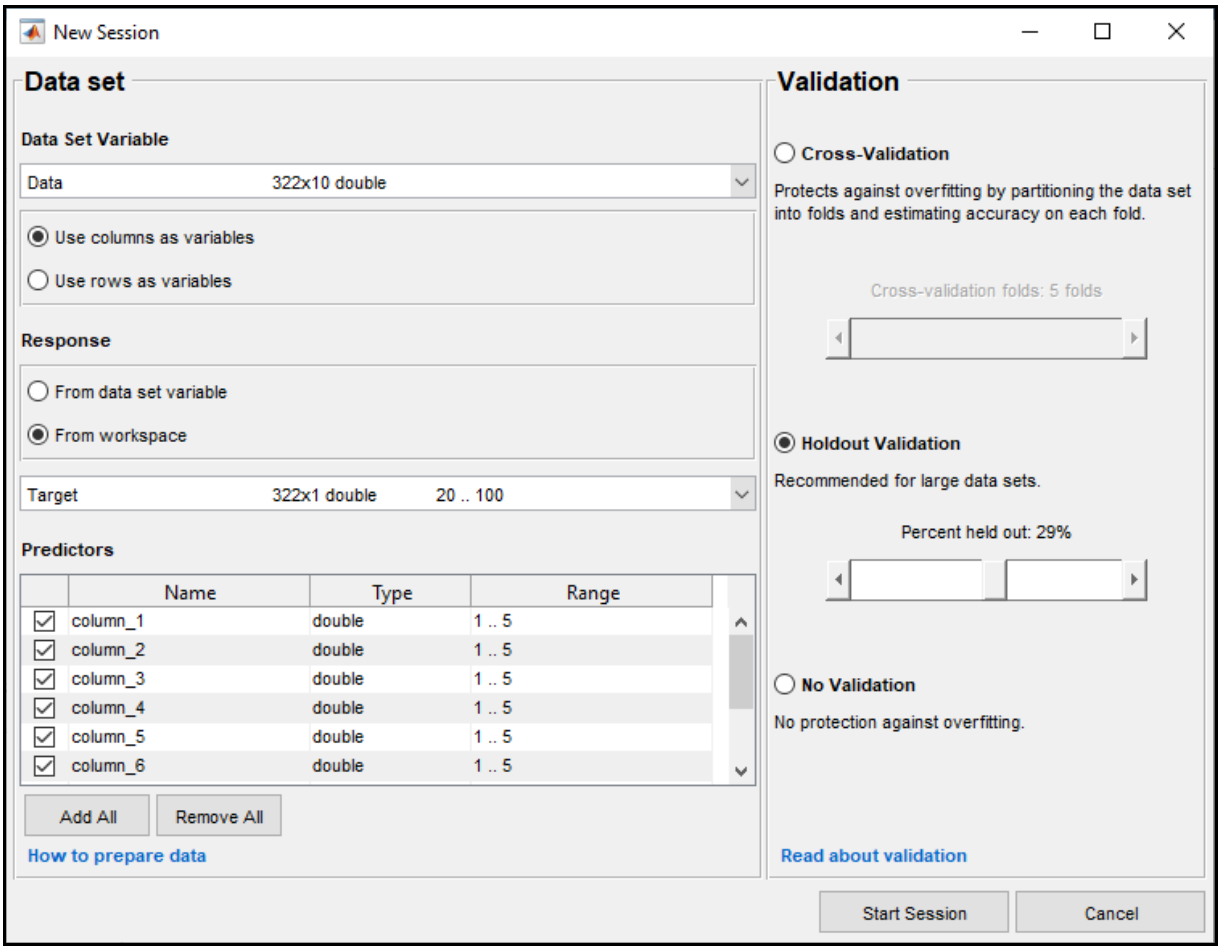


Figure 6.11 Data entry for the trained model with 29% Holdout validation

Figure 6.12 illustrate the input original data, which is the survey responses. The graph showing the results of the survey, the entered data and the levels of implementation (100, 70, 50, 20%) as per the survey. This data will be trained and tested to generate the forecasting model.

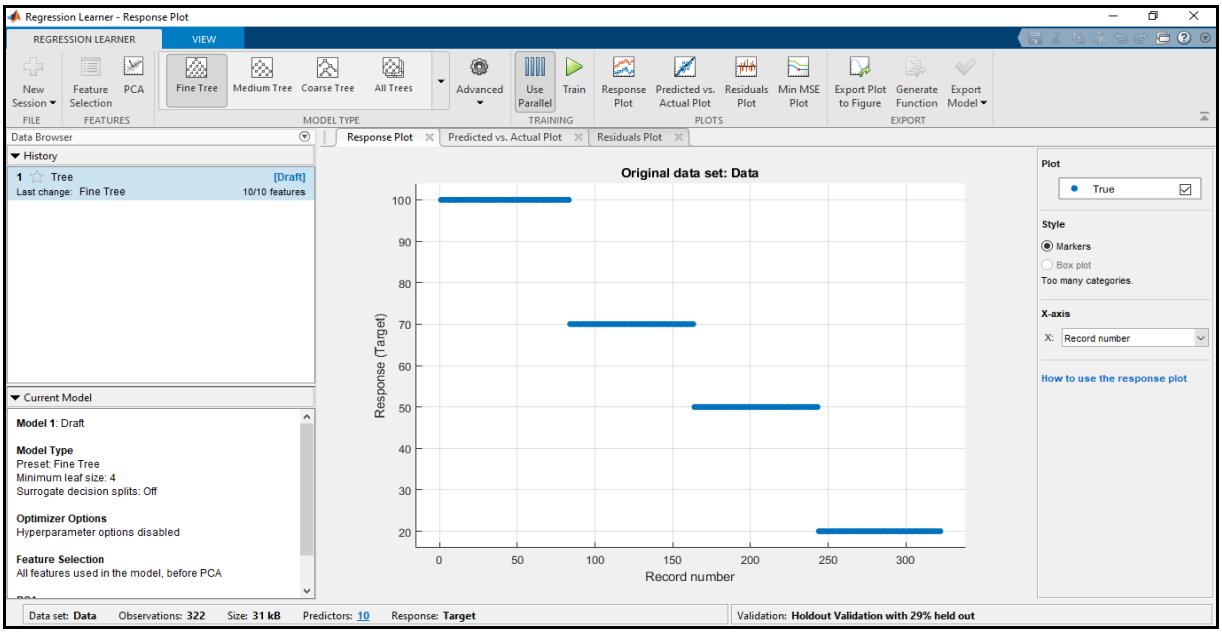


Figure 6.12 Response plot of the data

Figure 6.13, present the history list that shows the entire trained model using GPR tool and 29% holdout validation. The highlighted model is the best overall score. This score is the root mean square error (RMSE) on the validation set. All the performance indicators are listed in the Current model area. The results of the testing samples are presented and compared using statistical performance parameters in order to choose the best forecasting model.

The illustrated results show that **Exponential GPR model** give the best values among all iterations conducted.

This forecasting model is chosen to be the best because it has better RMSE results with a higher difference reflecting a better performance as in figure 6.14. The calculation results for RMSE, R^2, MSE, and MAE of the test sample are shown in Table 6.2.

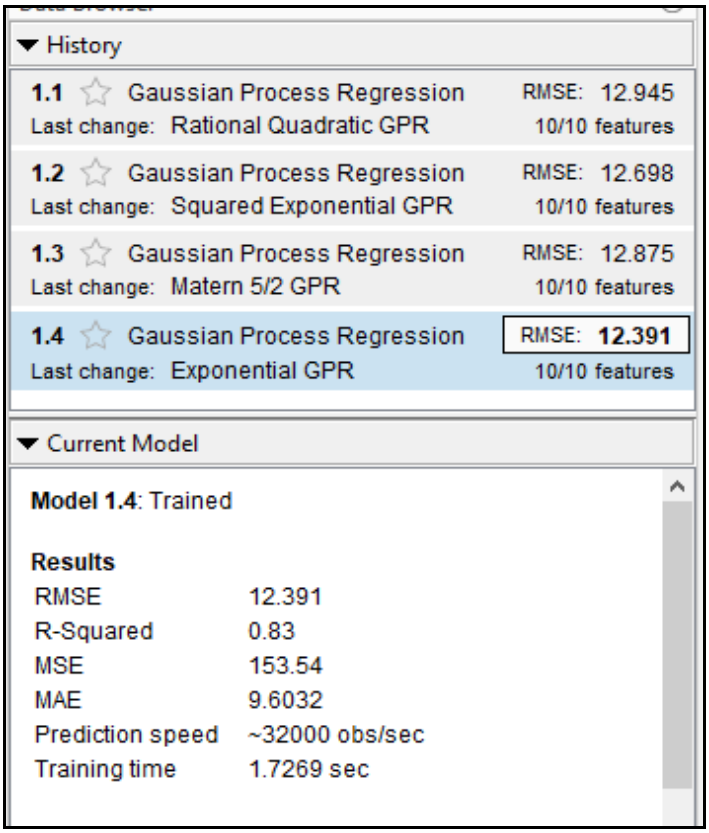


Figure 6.13

The History list show the models overall score

Table 6.2 Performance of Test Sample Model for Continues improvement

Root Mean Square Error	(RMSE)	12.391	Positive value - Small value
Coefficient of Determination	(R^2)	0.83	Smaller than one and larger then 0 Close to 1
Mean Squared error	(MSE)	153.54	Almost small value
Mean Absolute Error	(MAE)	9.6032	Positive value - Small value

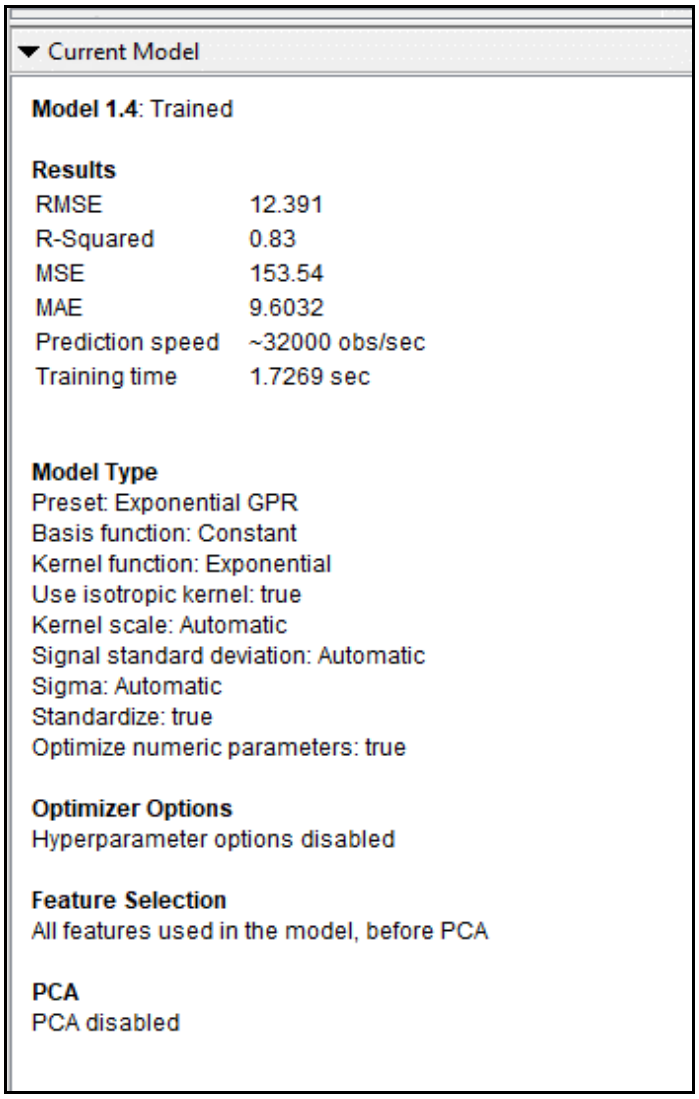


Figure 6.14 Model Statistics

Figure 6.15, the Response Plot, show prediction errors presented as vertical lines between the predicted and true responses.

The following figures represent the trained model performance results in Plots.

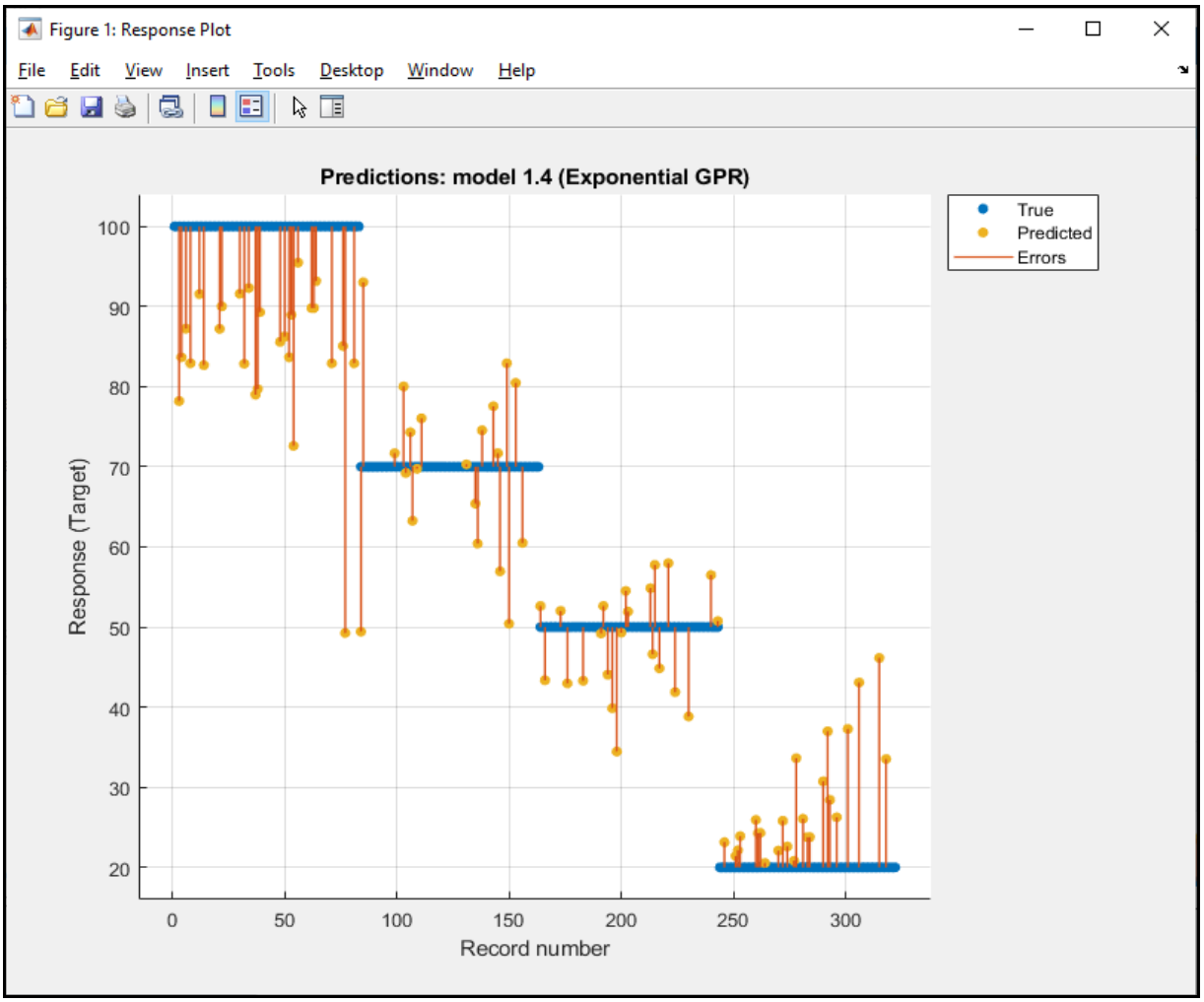


Figure 6.15 Response plot: Plot the actual versus predicted responses

Figure 6.16, shows the Predicted vs. Actual plot that used to check model performance after training the model. The predicted responses of the model are plotted against the actual, true responses. The forecasting model has predicted responses equal to the true responses, so all the points lie on the regression line. The vertical distances from the line to any point is the error of the prediction for that

point. The model is considered a good forecasting model since it has small errors, and predictions are scattered symmetrically around the diagonal line.

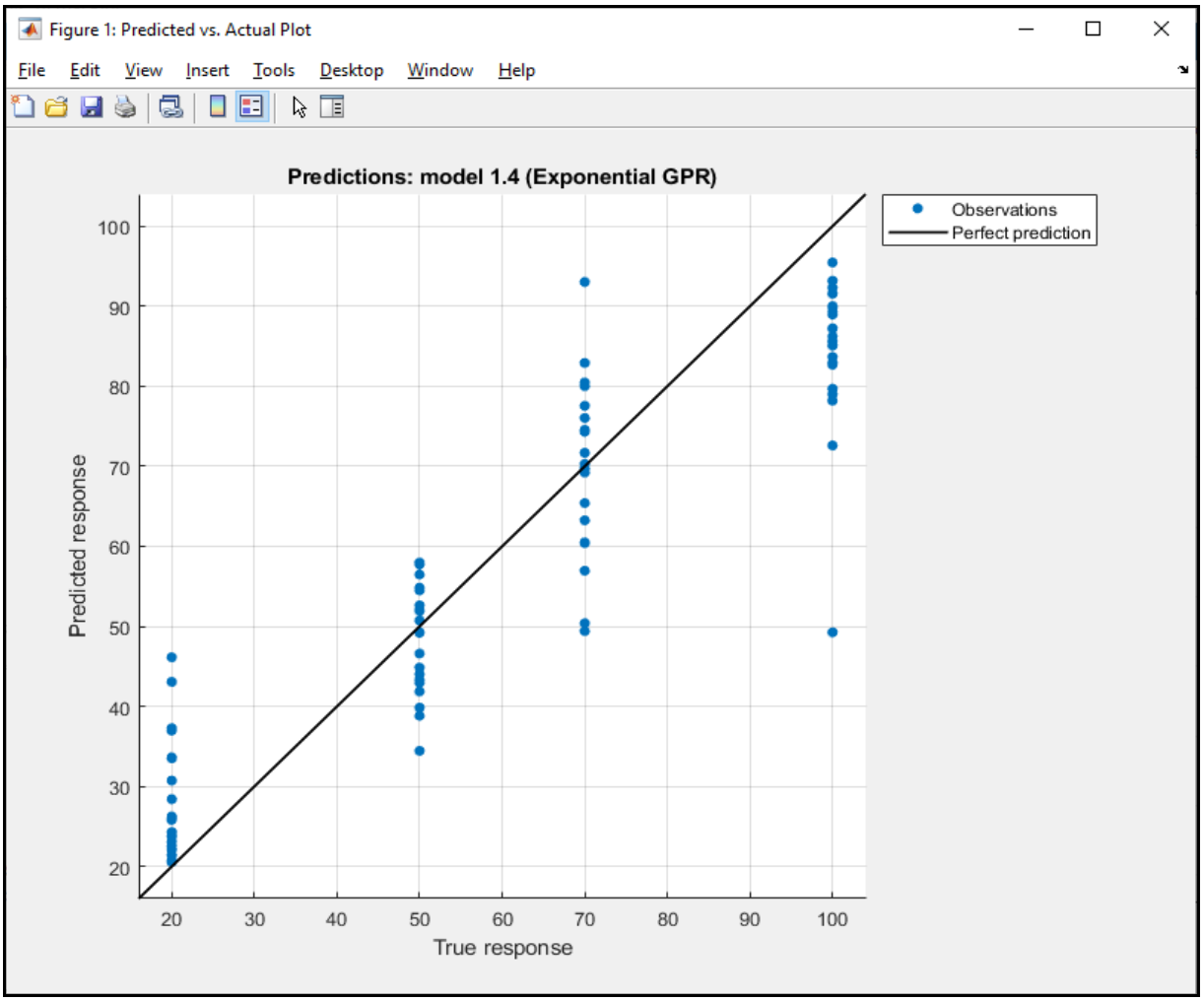


Figure 6.16

Plot Predicted vs. Actual Response

Figure 6.17, the residuals plot, displays the difference between the predicted and true responses. The Model is considered a good forecasting model, since the residuals scattered roughly symmetrically around 0.

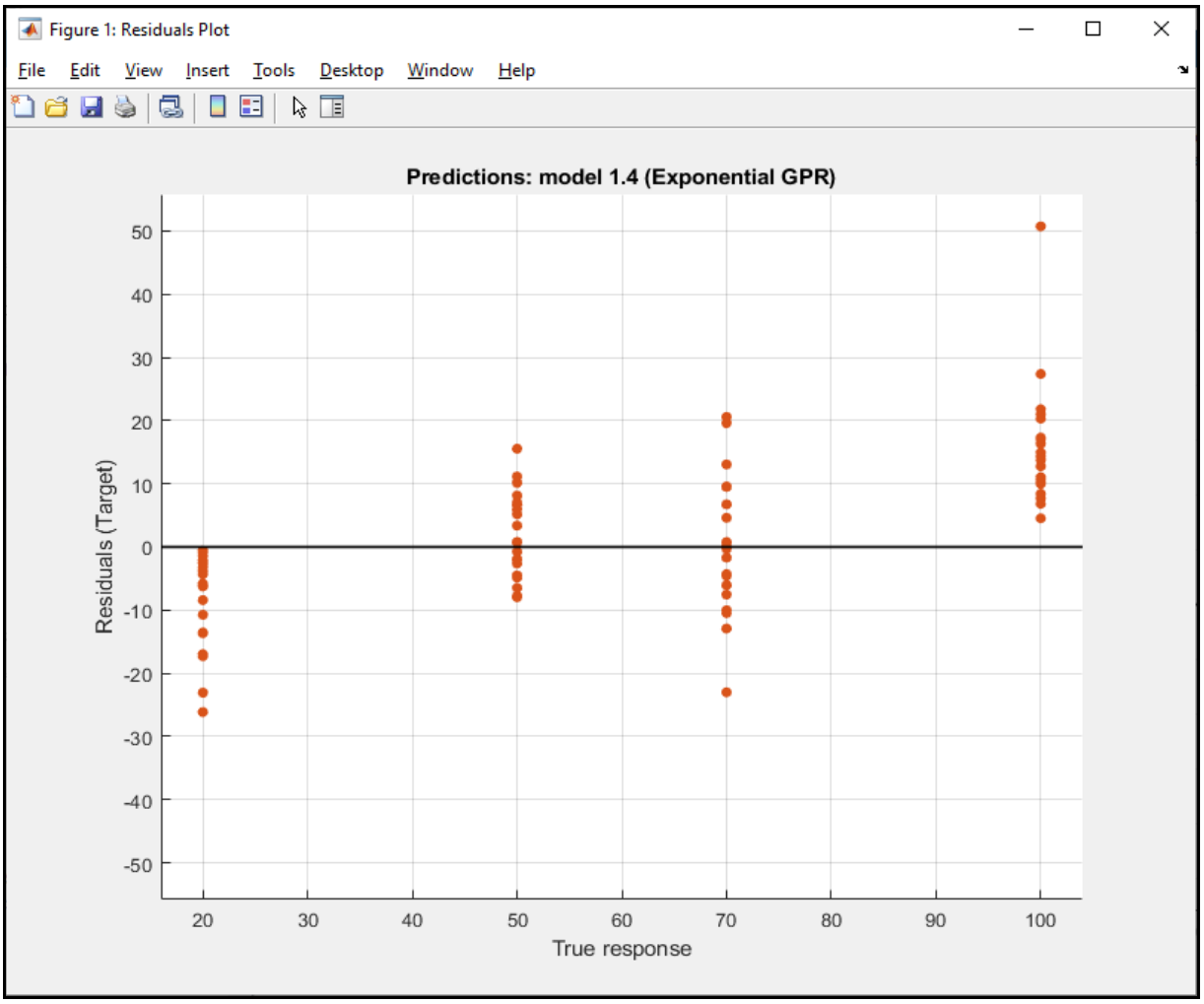


Figure 6.17

Residuals Plot

Figure 6.18, the Box Plot chart, displays the typical values of the response and any possible outliers. The central mark indicates the median, and the bottom and top edges of the box are the 25th and 75th percentiles, respectively. Vertical lines, called whiskers, extend from the boxes to the most extreme data points that are not considered outliers.

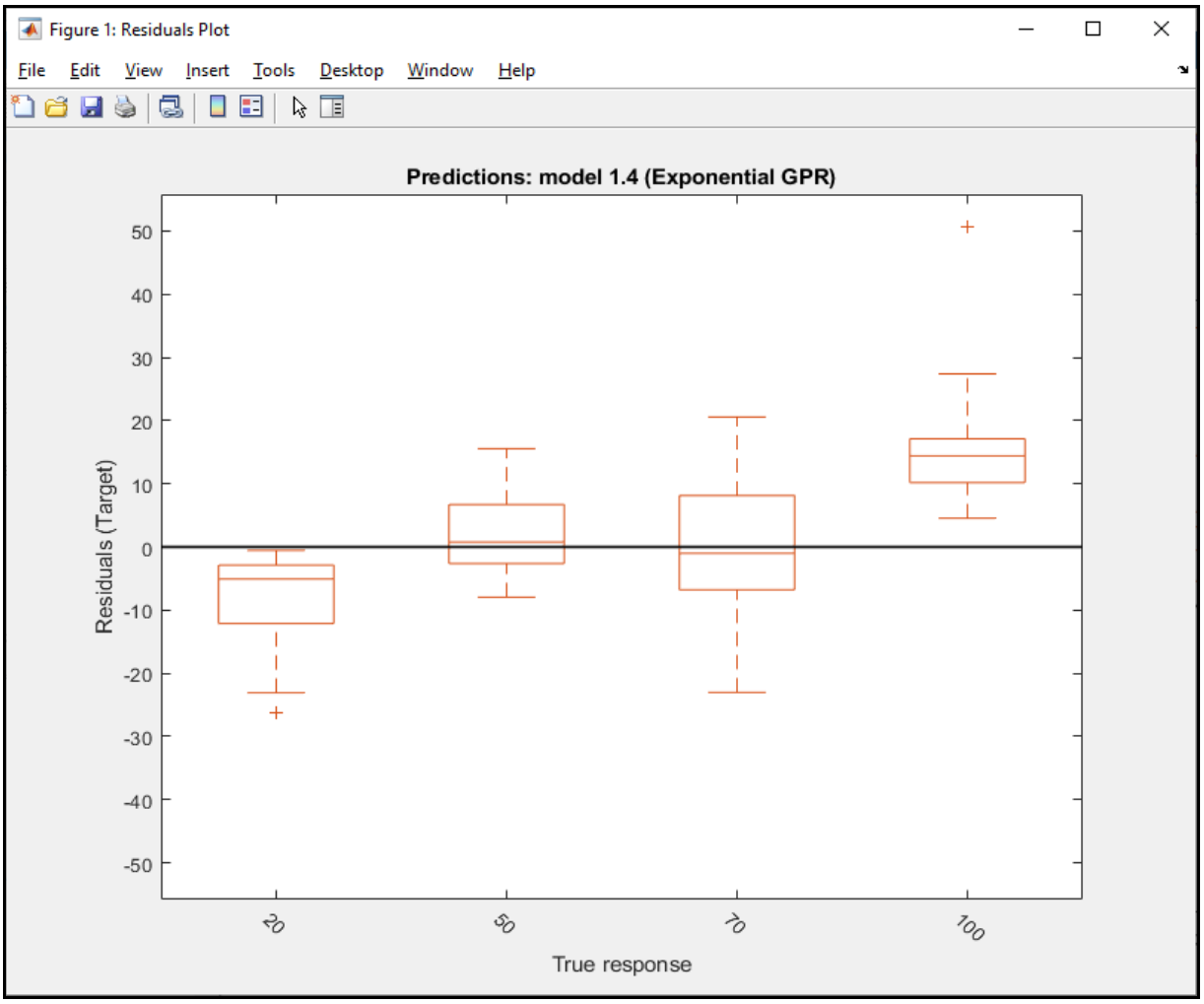


Figure 6.18 Box Chart plot

6.6 Summary of Results

The development of Leadership forecasting model and Continues improvement forecasting model passed through several steps, starting by choosing the type of model, cleaning the data set, choosing the software used to build the model, entering the dependent and independent variables, choosing the different parameters for each type of model, and finally training and testing the forecasting models, to choose the best forecasting model for the effective implementation of TQM elements.

A total of 190 models were trained, validated and tested for both forecasting models, using MATLAB.

The best performance model for **Leadership** developed using Gaussian Regression. This model fit the best by Rational Quadratic GPR, 10 cross-validation folds. The statistical performance indicators for this model has shown the minimum error results with RMSE of 0.62094, MSE of 0.38557 and MAE of 0.47391, while the Coefficient of Determination (R^2) is calculated as 0.75.

The best performance model for **Continues Improvement** developed using Gaussian Regression. This forecasting model fit the best by Exponential GPR model, 29% holdout validation. The statistical performance indicators for this model has shown the minimum error results with RMSE of 12.391, MSE of 153.54 and MAE of 9.6032, while the Coefficient of Determination (R^2) is calculated as 0.83.

After exporting the model, the app displays information about the exported model in the command window. The trainedModel structure will be used to make predictions for new data, X:

yfit = trainedModel.predictFcn(X)

where trainedModel is the name of the exported variable.

To use the model generated to test the data, supply the data X with the same format and data type as the training data used in the app (table or matrix). The format of the variables must match the original input data, in the same order and format.

Both Training Models and Codes for Leadership and Continuous improvement are available in the attached CD.

6.7 Chapter Summary

A Gaussian regression model built using the processed data executed from the questionnaire, using MATLAB software.

The forecasting model formulating process based on training number of models and compare validation results to choose the optimum forecasting model that produce the best performance. The exported will be used by the contractors to make new predictions on new data.

After applying the mentioned steps, the best performance models for Leadership and Continuous Improvement were selected. The evaluation approaches that have been used to test the forecasting model are Root Mean Square Error (RMSE), Coefficient of Determination R-squared values (R^2), Mean Squared Error (MSE), and Mean Absolute Error (MAE).

CHAPTER 7
Conclusion and Recommendations

7.1 Introduction

7.2 Conclusion

7.3 Limitation of the Study

7.4 Future Work Recommendations

Chapter 7
Conclusion and Recommendations

7.1 Introduction

TQM has been established as one of the concepts of contemporary management that aid to differentiate firms, and this has led to the endeavour carried by management in numerous firms to apply these concepts and principles aiming to continuously enhance and boost performance to reach its utmost potential, and fulfil the needs and preferences of all stakeholders. This chapter summarizes the outcomes from previous chapters and discuss the findings of this research with the results of previous studies. Additionally, it evidences that the aim and objectives of the study have been met. The first objective of this study was to assess the extent of TQM implementation effectiveness in mega building's construction projects in Bahrain. Finally, the second objective was to identify the critical success factors for TQM implementation in mega building's construction projects in Bahrain, meanwhile, the third objective was to develop a forecasting model for the effective implementation of TQM in the construction of mega building's construction projects in Bahrain.

7.2 Conclusion

Based on the findings of the present study, the following conclusions are drawn as follows:

1- Managers are disseminating quality's culture and stimulating employees to integrate quality management as a culture in all carried tasks and processes implemented. Thus, leading to improved competences of their employees in

performing the assigned tasks based on the premise that the improvement culture is the driver that can nurture spreading this culture. In another vein, some of the employees don't have a satisfactory extent of autonomy entitled by their managers as incorporating changes can be suggested by subordinates, but incorporating these changes into tasks is conditioned by getting their managers approval.

2- The firms' strategy is founded on enhancing relationships with customers, suppliers and other partnering and support the attainment of these firms long- and short-term goals. On the other hand, these firms lack possessing dynamic response towards the rapid changes and instability of the business environment.

3- The firms possess an enduring desire to sustain steady and substantial enhancement in all its operations, which enable them to enhance and distinguish their firms from competitors in their pursuit towards being creative and innovative. Meanwhile, the firms are heavily relying on their staff who are handling their assigned tasks and they are carrying on necessary improvement as per their job descriptions since there is no improvement team in the organization chart of these firms.

4- The firms' performance system is based on directing their employees to possess a customer centric approach, while performing every single task or job activity to assure their needs and exceeding their expectations. In another vein, despite the current customers' needs are identified and satisfied during the process of product or service provision, there is no set mechanism by some of these firms to reveal their feedback particularly after sales, thus their future insights are not investigated by these firms.

5- The firms are optimizing the stream of high quality and value for the cost of materials and supplies from their effective liaison with their capable and creative sub-contractors and suppliers. On the other hand, the subcontractors/suppliers are not engaged in the processes pertinent to the product design and quality enhancement that might impede the expedition of supplier response to provide data pertinent to quality issues.

6- The firms are embracing entire or fractional redesign of processes to line up operations with their requirements, thus their emphasis on processes have led to desirable outcomes in terms of sustaining their process management. Meanwhile, few firms are not catering to their customers' needs and expectation prior to the provision of services earlier within the design and development of services.

7- Managers are disseminating quality's culture and stimulating employees to integrate quality management as a culture in all carried tasks and processes implemented. This will subsequently improve the competences of their employees in performing the assigned tasks based on the premise that the improvement culture is the driver that can nurture spreading this culture. While on the other hand, some of the employees do not have a satisfactory extent of autonomy entitled by their managers as incorporating changes can be suggested by subordinates, but incorporating these changes into tasks is conditioned by getting their managers approval.

8- The firms are considering continuous improvement as an instrument to alter the direction of the performance, thus they are reviewing the processes and improving them to outperform and maintain profits to rise long-term returns. On the other hand, the employees in some of the firms that are not enrolling

them in sufficient training courses might be lacking the acquisition of some technical skills.

9- The firms' performance system is based on directing the employees to possess a customer centric approach, while performing every single task or job activity to assure their needs and exceeding their expectations. Whilst, employees in some firms are not entitled to share their thoughts and exchange their point of views within the improvement procedures.

10- The firms are optimizing the stream of high quality and value for the cost of materials and supplies from their effective liaison with their capable and creative sub-contractors and suppliers. On the other hand, subcontractors/ suppliers are not engaged in the processes pertinent to the product design and quality enhancement that might impede the expedition of supplier response to provide data pertinent to quality issues.

11- The firms are embracing entire or fractional redesign of processes to line up operations with their requirements, thus their emphasis on processes have led to desirable outcomes in terms of sustaining their process management. Meanwhile, some the investigated firms do not have the ability to analyze the activities needed to deliver the service, or to minimize the activities and business cycles that do not contribute to the product or service in terms of adding value.

12- Effective implementation of practices pertinent to human resources prompts employees to excel in their job activities, which nurture the development of these firms' activities. On the pother hand, the financial resources that supposed to be provided to support the improvement activities, unfortunately

it was concluded that these budgets are set in these firms towards the accomplishment of the construction projects, while there is no finance set aside for handling any needed improvements within these projects.

13- Employees training requirements pertinent to their assigned jobs, are analyzed and based on this training needs assessment they are enrolled in training programs that enable the acquisition of the skills and competencies to perform their job related activities efficiently. However, in another vein, employees in some of the firms lack insufficient and improper quality related training that might constitute a main obstacle of the successful implementation of TQM in these firms.

14- Management are more prone to generate an open and conducive culture that support employees to adhere to changes brought by this quality culture. Meanwhile, on the other hand, some employees in the firms do not have the tenet that building quality culture is a shared responsibility between the firm and its employees. In another word, both the management of this firm and employees are accountable for it.

15- *Top management's commitment* and *leadership* was the highest critical success factor. Thus, through this commitment, leaders are able to drive the transformation process towards quality in their firms, as particularly top management commitment is the starting point from which quality activities flow. The factor -*sharing lessons learned to understand how to evaluate quality processes for improvement*- as the least critical success factor. The managers in the firms have a belief that the evaluation of quality process is a typical managerial activity that fall under their job roles, accordingly there is

no need to share how quality processes are assessed and what are the potential benefits that can be reaped.

16- *In terms of TQM implementation (organizational performance)*, the most ranked ***area of improvement of TQM Implementation*** in the Construction of Mega Building Projects in Bahrain was to *increase productivity*. So managers and employees in the investigated firms are aspiring to raise their firm's productivity, as this increase will entail many advantages, such as increasing profits, achieving the desirable rate of return, preserving the firm's customers, and increasing the firm's market share. Oppositely, the least ranked ***area of improvement of TQM Implementation*** was that *employee turnover*. Therefore, the firms did not cater to the decrease in employee turnover.

17- *Lack or insufficient education and training* was the highly ranked barrier. Consequently, employees who hold improper educational degree or who did not get enrolled in sufficient training programs, will be reluctant towards the implementation of TQM as they might have a belief that the shift from traditional quality implementation towards TQM might constitute a real threat towards their job security as they might not be able to digest the TQM requirements and adopt it in all their job activities.

18- *Heavy documentation needed* was the least ranked barrier. Accordingly, the shift emerged in technology has enable firms to turn from traditional quality management approach relying on too much documentation towards smart e-formatting TQM where fewer documents are needed and are almost saved on computer after proper e-archiving which can highly expedite tracing these needed files upon request.

7.3 Limitation of the Study

This study was based on mega construction projects, where the sample constituted 67 out of these mega projects construction contractors, thus this sample size constituted a specific segment. The limitation was exclusion of medium and small construction projects, due to the time frame. Additionally, this study was based on Bahrain, thus the results cannot be generalized on other countries.

7.4 Further Work Recommendations

The following are recommendations to be considered for future studies:

1. Examine the same variables in a large-scale sample that might include mega construction projects, medium, and small size construction projects. Thereby, in generalizing the findings onto the whole construction sector in Bahrain.
2. Conduct a comparative study that investigate the impact of the critical success factors on TQM implementation among several countries, which may add more understanding towards the impact of successful TQM factors on the TQM implementation.

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Appendix A

Managerial Questionnaire

Assessment of TQM Implementation in the Construction of Mega Building Projects in Bahrain

Dear participant,

This survey is a partial fulfillment of the requirements for the Master Degree in Engineering Management program in University of Bahrain. The MSc thesis study titled "Assessment of TQM Implementation in Construction Projects of Buildings in Bahrain". It aims to investigate how far Bahraini companies implements TQM in building's construction projects, to solve the related problems, assess the degree of TQM implementation, identify the critical success factors, and barriers of this implementation.

The survey is exclusive to the leading construction companies in Bahrain and the respondents should be the employees related to the core functions of the building construction and its quality. This survey is targeting the managerial staff level.

The estimated time to complete the survey is 14 minutes. All responses will be held entirely anonymous, and will be used for research propose only. Thank you for your contribution to this scientific research.

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Section 1- General information

Your Highest Degree	○ PHD	○ Master	○ Bachelor	○ Diploma	○ Others
Your years of experience in the construction industry	○ Less than 5 years	○ From 5-10 years	○ More than 10 years		
Number of training courses related to quality in construction you participated	○ More than three	○ Three	○ Two	○ One	○ None
Your administrative level at your work	○ Managerial (manager of a department related to construction and/or quality)		○ Operational (Engineer / Technician / Site inspector/ quality officer)		

Section 2: Managerial Insights on Adopted Practices

This part contains questions related to top management practice and point of view.

Managerial Insights on Adopted Practices		
1	**What is the highest priority policy of the construction projects at your firm?**	□ Timely completion of the project within the budget □ Customer satisfaction □ Abide by quality standards □ Occupational health and safety □ Clean environment
2	**What is the quality system and/or approach that your firm adopts?**	□ Total Quality Management (TQM) □ ISO standards □ Statistical Quality Control □ Quality Assurance □ Six Sigma □ None
3	**How often do your firm measure customer satisfaction?**	□ Annually □ Semi-annually □ Quarterly □ Monthly □ None □ Other (Please Specify)

4	**What is your organization's purpose of quality?**	□ Elimination of defects □ A tool to increase profits □ A competitive advantage □ Other (Please Specify)
5	**Do you often rate suppliers and subcontractors**	□ Mostly □ Sometimes □ Rarely □ Never
6	**How does your organization solve quality related problems**	□ Assign an individual □ Form a multidisciplinary team for each problem □ A permanent team is available. □ Other (Please Specify)

Section 3- Success Factors of TQM implementation

This part is concerned with the Quality management application at your firm. Please rate the statements to personally describe the current status at your firm.

First Dimension: Leadership						
No.	**Statement**	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**
1	Management build an improvement culture					
2	Employees are involved in the decision- making					
3	Clear mission is developed regarding business objectives					
4	Management act as key driver in continuous improvement					
5	Communication links established between employees and management					
6	Management provide a proper and clear system to increase productivity					

7	Management encourages communication between employees and suppliers/ Subcontractors					
8	Employees are empowered to make significant changes on their daily activity					
Second Dimension: Policy and Strategy						
No.	**Statement**	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**
1	Management provide policies promoting customer satisfaction					
2	The concept of TQM is reflected in the firm's strategy, vision and mission					
3	The firm's policy and strategy are managed and reviewed on a regular basis					
4	Necessary resources available for achieving the firm's policy and strategy					
Third Dimension: Continuous Improvement						
No.	**Statement**	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**
1	The firm processes are improved regularly					
2	. Firm encourages innovation and creativity in process performance improvement					
3	. Improvement teams are exist in all functions					
4	. The quality improvement teams are effective					
5	. All Employees are trained to implement the continuous improvement philosophy in their daily activity					
6	. Sufficient training courses on quality improvement					

	tools and techniques are provided					
Fourth Dimension: Measurement and Feedback						
No.	**Statement**	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**
1	. Customer feedback is measured by customer surveys, focus groups, compliments and/or complaints					
2	. Data collection system monitors and predicts the improvement process					
3	. Employee's opinion and suggestions system is exist and considered in the improvement procedure					
4	. The main goal of performance measurement in our firm is to ensure that customer requirements have been met					
5	. The firm provides employees performance appraisal					
Fifth Dimension: Subcontractors and suppliers' quality management						
No.	**Statement**	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**
1	Subcontractors/suppliers are involved in processes improvement					
2	Subcontractors/suppliers audit and evaluation are important activities to be conducted					
3	Subcontractors/suppliers provide reliable quality data					
4	. The firm works with subcontractors/suppliers towards long term partnerships					

5	. Quality aspects is the basis of Subcontractors/suppliers selection					

Sixth Dimension: Processes Management						
No.	**Statement**	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**
1	Critical processes are identified					
2	Critical processes are improved					
3	. Critical processes are monitored					
4	. Critical processes are designed and developed based on customer needs and expectations					

Section 4- Critical Success Factors of TQM Implementation

There are certain specific factors that affect the success or failure of the TQM implementation, these factors are called Critical Success Factors of TQM implementation (CSF). Number of Critical Success Factors of TQM implementation are listed below. Please rate the listed factors in order of importance from 1 to 5 (5 is most important).

Critical Success Factors of TQM Implementation						
No.	**Statement**	**Not Important at all**	**Slightly Important**	**Moderately Important**	**Important**	**Extremely Important**
1	Top management's commitment and leadership					
2	Organizational culture					
3	Quality education and training					

4	Communication between top managers and employees					
5	Subcontractors and suppliers assessment procedures					
6	Long-term relationships with subcontractors and suppliers					
7	Teamwork					
8	Measuring customer satisfaction periodically					
9	Employees’ involvement					
10	Employees’ satisfaction					
11	Business environment					
12	Time management					
13	Build long-term relationships With clients					
14	Continuous improvement					
15	Employees empowerment					
16	Company's quality policy					
17	Process management					
18	Availability of comprehensive quality information					
19	Innovation strategy					
20	Quality to be assessed at recruitment stage for skilled labours					
21	Sharing lessons learned to understand how to evaluate quality processes for improvement					
22	Understanding of client's requirements and expectations of the project outcome					

23	Planning realistically for time, budget, material and human resources					

Section 5- TQM Implementation (Organizational Performance)

Number of statements related to the Organizational performance of TQM implementation are listed below. Please rate the statements in order of importance from 1 to 5 (5 is most important).

TQM Implementation (Organizational Performance)						
No.	**Statement**	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**
1	Customer satisfaction has increased					
2	The competitive position of your company has strengthened					
3	The waste has reduced					
4	Production deficiencies reduction					
5	The profit has increased (Profit maximization)					
6	The occupational accidents minimized					
7	Employees job satisfaction and motivation has increased					
8	Timely completion of the project					
9	The productivity has improved					

10	The firm’s overall market share has increased					
11	Increased client loyalty and retention and reduced customer complaints					
12	Adaptability to changing or emerging market conditions and government regulations					
13	Change order has reduced					
14	Positive change in employees skills, knowledge and abilities					
15	Employees performance has improved					
16	Improved and innovative processes cause efficiency improvement					
17	Employee turnover has decreased					

Section 6- Barriers to TQM implementation

Number of Barriers of TQM implementation are listed below. Please rate the listed barriers in order of importance from 1 to 5 (5 is most important).

Barriers to TQM implementation						
No.	**Statement**	**Not Important at all**	**Slightly Important**	**Moderately Important**	**Important**	**Extremely Important**
1	Lack of top-management commitment					
2	Lack or insufficient education and training					

3	Perception of costly and time consuming of TQM application					
4	Heavy documentation needed					
5	Low bid subcontractors selection (low bid mindset)					
6	Lack of financial and/or human resources					
7	Lack of employees' involvement					
8	Lack of communication between top managers and employees					
9	Challenges in changing organizational culture					
10	Lack of long-term sustainability					
11	Incompatibility of standardized quality management system with the construction industry					
12	Need for conducting continuous training programs for employee					
13	frequent design changes					
14	Poor design capacity					
15	Incompetence of project team					
16	Financial difficulties of owner					
17	Government policies and regulations					
18	Lack of experience in complex projects					
19	Improper planning and scheduling					
20	Lack of knowledge and ability in managing construction projects					
21	Corruption and bribery in construction projects					
22	The delays in payment					

23	Economic volatility					
24	Lack of a systematic approach to manage the project					
25	Poor performance of contractors/ sub-contractors					
26	Lack of integration between TQM and existing systems					
27	lack of integration of internal and external customer-supplier chains					

Appendix B

Operational Questionnaire

Assessment of TQM Implementation in the Construction of Mega Building Projects in Bahrain

Dear participant,

This survey is a partial fulfillment of the requirements for the Master Degree in Engineering Management program in University of Bahrain. The MSc thesis study titled "Assessment of TQM Implementation in Construction Projects of Buildings in Bahrain". It aims to investigate how far Bahraini companies implements TQM in building's construction projects, to solve the related problems, assess the degree of TQM implementation, identify the critical success factors, and barriers of this implementation.

The survey is exclusive to the leading construction companies in Bahrain and the respondents should be the employees related to the core functions of the building construction and its quality. This survey is targeting the operational staff level.

The estimated time to complete the survey is 14 minutes. All responses will be held entirely anonymous, and will be used for research propose only. Thank you for your contribution to this scientific research.

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Section 1- General information

Name of your Firm					
Educational Level	○ PHD	○ Master	○ Bachelor	○ Diploma	○ Others
Years of experience in the construction industry	○ Less than 5 years	○ From 5-10 years	○ More than 10 years		
Number of enrolled training courses related to quality in construction	○ More than three	○ Three	○ Two	○ One	○ None
Job Level	○ Managerial (manager of a department related to construction and/or quality)		○ Operational (Engineer / Technician / Site inspector/ quality officer)		

Section 2- Background

This part contains questions related to your personal understanding and practice of quality.

Background		
1	In your opinion which of these terminologies defines quality the best?	□ Meet customer expectations □ Meet standards and codes □ Meet employee satisfaction □ Quality certification □ Teamwork □ Increased profit □ within budget □ Extra costs □ Waste of time

2	In your opinion what is the relationship between ISO standards and TQM?	□ Similar to each other □ ISO standards is a part of TQM □ Totally different from each other
3	What is the highest priority policy of the construction projects at your firm?	□ Timely completion of the project □ Within budget □ Customer satisfaction □ Abide by quality standards □ Occupational health and safety □ Clean environment
4	Which quality improvement tool or technique your firm use?	□ Plan Do Check Act □ Quality Function Deployment □ Failure mode & Effect analysis □ Pareto analysis □ Histogram □ Cause and effect diagram □ Flow chart □ Scatter diagram □ Check sheet □ Nominal Group Technique Statistical control charts □ Why-Why Diagram □ None

Section 3- Success Factors of TQM

This part is concerned with the Quality management application at your firm. Please rate the statements to personally describe the current status at your firm.

First Dimension: Leadership						
No.	**Statement**	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**
1	Management build an improvement culture					
2	Employees are involved in the decision- making					
3	Clear mission is developed regarding business objectives					

4	Management act as key driver in continuous improvement					
5	Communication links established between employees and management					
6	Management provide a proper and clear system to increase productivity					
7	Management encourages communication between employees and suppliers/ subcontractors					
8	Employees are empowered to make significant changes on their daily activity					
Second Dimension: Continuous improvement						
No.	**Statement**	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**
1	The firm processes are improved regularly					
2	. The firm encourages innovation and creativity in process performance improvement					
3	. Improvement teams are exist in all functions					
4	. The quality improvement teams are effective					
5	. All Employees are trained to implement the continuous improvement philosophy in their daily activity					
6	. Sufficient training courses on quality improvement tools and techniques are provided					
Third Dimension: Measurement and Feedback						
No.	**Statement**	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**

1	Customer feedback is measured by customer surveys, focus groups, compliments and/or complaints					
2	Data collection system monitors and predicts the improvement process					
3	Employee's opinion and suggestions system is exist and considered in the improvement procedure					
4	The main goal of performance measurement in our firm is to ensure that customer requirements have been met					
5	. The firm provides employees performance appraisal					
Fourth Dimension: Subcontractors and suppliers quality management						
No.	**Statement**	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**
1	Subcontractors/suppliers are involved in processes improvement					
2	Subcontractors/suppliers audit and evaluation are important activities to be conducted					
3	Subcontractors/suppliers provide reliable quality data					
4	. The firm works with subcontractors/suppliers towards long term partnerships					
5	. Quality aspects is the basis of Subcontractors/suppliers selection					
Fifth Dimension: Processes Management						
No.	**Statement**	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**

1	Critical processes are identified					
2	Critical processes are improved					
3	. Critical processes are monitored					
4	. Critical processes are designed and developed based on customer needs and expectations					
Sixth Dimension: Resources Management						
No.	**Statement**	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**
1	. Sufficient financial resources are provided to support the improvement activities					
2	. Human resources is considered in improvement activities					
3	. Technical resources (e.g. software, equipment) are provided					
4	. Resources are effectively deployed in the development of firm's activities					
Seventh Dimension: Education and training						
No.	**Statement**	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**
1	Continuous learning is provided through education and training courses					
2	Employees are trained for the needed job skills set					
3	Employees are trained on TQM concepts					
4	Sufficient training time is provided for employees					

Eighth Dimension: Work environment and culture						
No.	**Statement**	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**
1	Employees have good compliance to the quality culture change					
2	The current statues motivates employees to contribute towards building a quality culture					

Section 4- Critical Success Factors of TQM Implementation

There are certain specific factors that affect the success or failure of the TQM implementation, these factors are called Critical Success Factors of TQM implementation (CSF). Number of Critical Success Factors of TQM implementation are listed below. Please rate the listed factors in order of importance from 1 to 5 (5 is most important).

Critical Success Factors of TQM Implementation						
No.	**Statement**	**Not Important at all**	**Slightly Important**	**Moderately Important**	**Important**	**Extremely Important**
1	Top management's commitment and leadership					
2	Organizational culture					
3	Quality education and training					
4	Communication between top managers and employees					
5	Subcontractors and suppliers assessment procedures					

6	Long-term relationships with subcontractors and suppliers					
7	Teamwork					
8	Measuring customer satisfaction periodically					
9	Employees’ involvement					
10	Employees’ satisfaction					
11	Business environment					
12	Time management					
13	Build long-term relationships With clients					
14	Continuous improvement					
15	Employees empowerment					
16	Company's quality policy					
17	Process management					
18	Availability of comprehensive quality information					
19	Innovation strategy					
20	Quality to be assessed at recruitment stage for skilled labours					
21	Sharing lessons learned to understand how to evaluate quality processes for improvement					
22	Understanding of client's requirements and expectations of the project outcome					
23	Planning realistically for time, budget, material and human resources					

Section 5- TQM Implementation (Organizational Performance)

Number of statements related to the Organizational performance of TQM implementation are listed below. Please rate the statements in order of importance from 1 to 5 (5 is most important).

TQM Implementation (Organizational Performance)						
No.	**Statement**	**Strongly disagree**	**Disagree**	**Undecided**	**Agree**	**Strongly agree**
1	The productivity has improved					
2	Timely completion of the project					
3	Customer satisfaction has increased					
4	Employees performance has improved					
5	The profit has increased (Profit maximization)					
6	Employees job satisfaction and motivation has increased					
7	Positive change in employees skills, knowledge and abilities					
8	The competitive position of your company has strengthened					
9	The waste has reduced					
10	Improved and innovative processes cause efficiency improvement					
11	Production deficiencies reduction					
12	The firm’s overall market share has increased					
13	The occupational accidents minimized					
14	Increased client loyalty and retention and reduced customer complaints					
15	Change order has reduced					
16	Adaptability to changing or emerging market					

	conditions and government regulations					
17	Employee turnover has decreased					

Section 6- Barriers to TQM implementation

Number of Barriers of TQM implementation are listed below. Please rate the listed barriers in order of importance from 1 to 5 (5 is most important).

Barriers to TQM implementation						
No.	**Statement**	**Not Important at all**	**Slightly Important**	**Moderately Important**	**Important**	**Extremely Important**
1	Lack of top-management commitment					
2	Lack or insufficient education and training					
3	Perception of costly and time consuming of TQM application					
4	Heavy documentation needed					
5	Low bid subcontractors selection (low bid mindset)					
6	Lack of financial and/or human resources					
7	Lack of employees' involvement					
8	Lack of communication between top managers and employees					
9	Challenges in changing organizational culture					
10	Lack of long-term sustainability					
11	Incompatibility of standardized quality management system with the construction industry					

12	Need for conducting continuous training programs for employee					
13	frequent design changes					
14	Poor design capacity					
15	Incompetence of project team					
16	Financial difficulties of owner					
17	Government policies and regulations					
18	Lack of experience in complex projects					
19	Improper planning and scheduling					
20	Lack of knowledge and ability in managing construction projects					
21	Corruption and bribery in construction projects					
22	The delays in payment					
23	Economic volatility					
24	Lack of a systematic approach to manage the project					
25	Poor performance of contractors/ sub-contractors					
26	Lack of integration between TQM and existing systems					
27	lack of integration of internal and external customer-supplier chains					

Appendix C

MINISTRY OF WORKS

LIST OF BUILDINGS CONTRACTORS REGISTERED WITH MINISTRY OF WORKS

(OVER BD.: 6,000,000/-)

CONSTRUCTION PROJECTS- GRADE AA

Sno	Contractor Name	CR No.	PO Box	Tel. No.	FAX No.	Comments	Email
1	CHINA JIANGSU CONSTRUCTION CORPORATION (THE AGENT : SINOGIC INVESTMENT HOLDING COMPANY W.L.L.)	1	5780	17790090	17790154	International not valid, needed to be renewed[Expired License]	
2	OLYMPIC CONTRACTING CO. W.L.L.	44242	20628	17343981	17343984	[Expired License]	info@olympic.bh
3	TECHNICAL CONSTRUCTION COPMANY W.L.L.	1840-1	5174	17730036	17730064		tccbn@batelco.com.bh
4	A.AHMED NASS CONTRACTING CO.	17537-3	669	17708333	17701714	[Expired License]	estimation@nasscontracting.com
5	BAHRAIN MOTORS COMPANY	18673-1	352	77006262	77006161		info@almuharikat.com
6	AHMED MANSOOR ALAALI	571-2	778	17250521	17262323		headoffice@al-aali.com
7	CEBARCO BAHRAIN S.P.C	27738-1	28812	17722237	17722001		Cebarco@kar-group.com
8	G.P.ZACHARIADES OVERSEAS LIMITED	4595	5632	17598800	17598801	[Expired License]	info@gpzgroup.com
9	HABIB ALI AWACHI & SONS CONTRACTING CO. W.L.L.	31094-1	2041	17400056	17400399	Not Valid - To be Renewed[Expired License]	
10	BOKHOWA CONTRACTING & TRADING GROUP W.L.L .	4702-2	5422	17259980	17256836		info@bokhowagroup.com
11	JOINT STOCK COMPANY RUSSIAN RAILWAY (THE AGENT, GR GROUP W.L.L.)	1		17587001	17587006	International not valid, need to be renewed[Expired License]	
12	KAZEROONI CONTG. W.L.L.	1567-2	5385	17742595	17712184		
13	KOOHEJI CONTRACTORS W.L.L.	3247-2	1041	17786500	17786565		inquiry@kcbahrain.com
14	MOHAMED JALAL CONTRACTING CO. W.L.L	50795-1	113	17255360	17259839 /17259723		mjcont@batelco.com.bh
15	PROJECTS CONSTRUCTION COMPANY W.L.L.	5141	801	17731298	17732673	[Expired License]	construction@projectsbahrain.com
16	SALEH ABDULLA KAMESHKI & sons b.s.c. CLOSED	1474-1	2219	17250627	17270478		info@kameshki.com
17	BURHAN INTERNATIONAL CONSTRUCTION CO. BAHRAIN S.P.C.	67534-1	11762	00965 24645184	17530618	International [Expired License]	Mustafas@burhaninternational.com
18	NAMKWANG ENGINEERING AND CONSTRUCTION CO. LTD (LOCAL AGENT/SPONSOR : RED INTERNATIONAL BROKERS)	1		822-30110482	822-30110468	International [Expired License]	

MINISTRY OF WORKS

LIST OF BUILDINGS CONTRACTORS REGISTERED WITH MINISTRY OF WORKS

(OVER BD.: 6,000,000/-)

CONSTRUCTION PROJECTS- GRADE AA

Sno	Contractor Name	CR No.	PO Box	Tel. No.	FAX No.	Comments	Email
19	TAMCON CONTRACTING CO. B.S.C. CLOSED	67130-1	P.O.Box-10119	77468888	77468877		zahmed@tamcon.bh
20	ALGHANAH CONTRACTING	15648-1	2510	17722333	17722233	[Expired License]	INFO@ALGHANAH.COM
21	CONCTRUTORA OAS LTDA (BRASIL)	14.310.577/(		39718305/551 121241122	-	International [Expired License]	
22	ALHABTOOR LEIGHTON BAHRAIN S.P.C	75986	20750	17502770	17503030	GCC not valid needed to be renwed[Expired License]	
23	ROBODH CONTRACTING CO. L.L.C.	48504	60889	+97142820844	+97142820842	[Expired License]	
24	GRANDI LAVORI FINCOSIT S.P.A	1	-	+3906881711	+39068813051	International [Expired License]	
25	SAYED KADHEM ALDURAZI & SONS B.S.C. CLOSE	2111-1	1060	17620672	17624116	[Expired License]	
26	KUWAIT MANAGER CONTRACTING S.P.C	55344	2307	77722722	77722711	International [Expired License]	
27	SHAPOORJI PALLONJI MIDEAST L.L.C	-	21928	+97172690334	+97142690335	International [Expired License]	
28	KYERYONG CONSTRUCTION INDUSTRAIL CO .	80828-1	KOREA	+82424807434	+82424807288	International [Expired License]	
29	UNAL AKPINAR CONSTRUCTION INDUSTRY TOURISM MINING AND TRADE INC. (LOCAL AGENT : ALWARDI CONSTRUCTION)	306207	23678	+90-312-4687960	+90-312-4689341	International [Expired License]	akpinar@akpinargroup.com.tr
30	CONSOLIDATED CONTRACTORS (BAHRAIN) COMPANY	703	583	17221511	17221154	International [Expired License]	
31	RIZZANI DE ECCHER BAHRAIN S.P.C.	76012-1		+3904326071	+390432607373	International	ugare@rde.it
32	SAMCRETE ENGINEERING AND CONTRACTING	16866		0020233891100	002023389112 2	International [Expired License]	
33	ALAMIAH BUILDING COMPANY K.S.C.C	20980	280 Jahra	00965 25661095	00965 25661086	GCC	info@alamiahco.net
34	PWT WASSER-UND ABWASSERTECHNIK GMBH	HRB 25471		00496251980401	00496251980498	International not valid needed to be renewed[Expired License]	boeckle.ruediger@pwt.de
35	CHINA GEZHOUBA GROUP COMPANY LIMITED	42000000000(		00861059525828	00861059525859	International not valid needed to be renewed[Expired License]	dirkyoung@hotmail.com
36	DAR AL KHALEEJ TRADING & CONTRACTING W.L.L.	20888-1	54727	17292851	17295742		info@dak-tc.com
37	AL WARDI CONSTRUCTION	12131-1	26378	17730626	17731565	not valid needed to be renewed[Expired License]	info@alwardi.com

MINISTRY OF WORKS

LIST OF BUILDINGS CONTRACTORS REGISTERED WITH MINISTRY OF WORKS

(OVER BD.: 6,000,000/-)

CONSTRUCTION PROJECTS- GRADE AA

Sno	Contractor Name	CR No.	PO Box	Tel. No.	FAX No.	Comments	Email
38	NASS CONTRACTING COMPANY W.L.L.	17537-1	669	17708333	17701714		INFO@NASSCONTRACTING.COM
39	TERNA CONTRACTING W.L.L.	68262-1	54368	17721048	17741096	[Expired License]	MAIN@TERNA.BH
40	SIX CONSTRUCT LTD CO.	46982	50491	13634523	17179761	International	vivekm@sixco.com
41	FU-TAI ARABIA LLC	2051042903		+966138949716	+966138941074	GCC	f.alsinan@futai-arabia.com
42	DADABHAI CONSTRUCTION	47989-2	20531	17255209	17251995		ceo.dadabhai@batelco.com.bh
43	ARADOUS CONTRACTING AND MAINTENANCE CO. W.L.L.	69183-1	2807	17740523	17740515		info@aradouscm.com
44	CYPRUS BUILDING AND ROAD CONSTRUCTION COMPANY LIMITED W.L.L.	63728-1	15954	17275787	17262744	[Expired License]	
45	M-10 BUILDERS W.L.L.	69850-1	75704	17552935	17369883	[Expired License]	
46	HAFEERA-IJM CONTRACTING W.L.L.	67455-1	28141	17730343	17732187	[Expired License]	
47	MOHAMMED ABDULMOHSIN AL-KHARAFI & SONS FOR GENERAL TRADING, GENERAL CONTRACTING AND INDUSTRIAL STRUCTURES W.L.L.	53472	20618	+96522323300	+96522323315		a.wafik@kcmak.net
48	POULLAIDES CONSTRUCTION COMPANY W.L.L.	48613	33411	17826660	17827008		pccbah@batelco.com.bh
49	ALMOAYYED CONTRACTING W.L.L.	76979-1	3251	17404949	17402639		contracting@almoayyedcg.com
50	ALHAFEERA CONTRACTING COMPANY W.L.L.	13336-1	28411	17730343	17732187		info@hafeera.com
51	IACOVOU BROTHERS (CONSTRUCTIONS) LIMITED	11445-0	40140 LARNACA, CYPRU	00357242577777	0035724650051	International	info@iacovougroup.com

Count : 51

MINISTRY OF WORKS

LIST OF BUILDINGS CONTRACTORS REGISTERED WITH MINISTRY OF WORKS

(UP TO BD.: 6,000,000/-)

CONSTRUCTION PROJECTS- GRADE A

Sno	Contractor Name	CR No.	PO Box	Tel. No.	FAX No.	Comments	Email
1	ALDHAHRANI CONTRACTING COMPANY W.L.L.	13171-1	5763	17611332	17611553	A[Expired License]	dahrani5@batelco.com.bh
2	M. & I. CONSTRUCTION LTD. CO.	5697	5697	17728340	17727321	[Expired License]	spacemkr@batelco.com.bh
3	AL KHALIDIA CONTRACTING CO. W.L.L.	12059-1	5406	17346802	17340136	[Expired License]	kumar@olympic.bh
4	HAMEED AL NOOH CONTG & TRDG	1464-2	20740	17270398	17263684	[Expired License]	
5	KHALID ALI AL-KHARAFI & BROS. CO./KHARAFI STEEL	50045-1	574	17531316	17531314	[Expired License]	
6	AL NASIR CONTRACTING W.L.L.	8187-1	15858	17714609	17713247	[Expired License]	nasirconst.com
7	ALARGAN NATIONAL GENERAL TRADING & CONTRACTING CO.	66493-1	21186	17563600	17564128	[Expired License]	
8	AAA HOMES CONTRACTING W.L.L.	47915-3	31191	17811353	17826768	[Expired License]	
9	SHADE CORPORATION LTD	62789-1	75883	17588249	17464023	[Expired License]	
10	GANNON DUNKERLEY MIDDLE EAST W.L.L.	68193-1	76162	17310012	17310018	[Expired License]	
11	ABDULAAL CONST SERVICES S.P.C	7520	20418	17533999	17533236	[Expired License]	amsconet@batelco.com.bh
12	MOSOBLPROMSTROY	53076-1	BLOCK3,BUID3 ,MOSCOW	+74991889738	+74991889738	International [Expired License]	
13	SAUDI BUILD INTERNATIONAL CONTRACTING W.L.L.	65838	75754	13333651	13324010	[Expired License]	
14	SKYLINE TRADING CORPORATION	37958	3207	17598008	17590338		stc3207@batelco.com.bh
15	ABDULLA HASSAN ALDURAZI & SONS CO.	19015-1	697	17564664	17564644		admin@ahalderazi.com
16	AHMED OMER TRADING & CONTRACTING EST.W.L.L.	1659-1	5098	17258545	17233882	[Expired License]	aogroup@batelco.com.bh
17	ABDULRAHMAN ABDULLA ALMANSOORI CONTRACTING CO. W.L.L.	29389-1	37263	17786698	17785598	[Expired License]	info@asmcontracting.net
18	ALHEDAYA CONTRACTING COMPANY	7691-1	5705	17728800	17725121	[Expired License]	ALHEDAYA@ALHEDAYACO.COM
19	ALJAMEEL CONSTRUCTION S.P.C	78240-1	75637	17213003	17210103		jtcwll@gmail.com

MINISTRY OF WORKS

LIST OF BUILDINGS CONTRACTORS
REGISTERED WITH MINISTRY OF WORKS

(UP TO BD.: 6,000,000/-)

CONSTRUCTION PROJECTS- GRADE A

Sno	Contractor Name	CR No.	PO Box	Tel. No.	FAX No.	Comments	Email
20	AL QAWAREER CONTRACTING CO.W.L.L	55362-1	24260	17786149	17786349	[Expired License]	aqcc.bh@gmail.com
21	DOWNTOWN CONSTRUCTION COMPANY W.L.L.	8899-1	26312, Kingdom Of Ba	17404866	17404714		contractsmanager@downtownbh.com
22	ASEERI CONSTRUCTIONS	50697-1	26083	17744122	17744133	[Expired License]	aseerico@batrlco.com.bh
23	FUNDAMENT SPC	69393-1	659	17369322	17369344	[Expired License]	info@fundamentspc.com
24	CHARILAOS APOSTOLIDES & CO. (BAHRAIN) W.L.L.	12640	1987	17830190	17830183		chapo@chapobahrain.com
25	RAWABI SPECIALIZED CONTRACTING	2051013824	30445	00966500136240	00966138124209	International	info@rscc.com.sa
26	YOUSIF AL-ZAYANI TRADING & CONTRACTING CO.	1245-1	5542	17227146	17224181		zayanico@batelco.com.bh

Count : 26

Appendix D

The quality improvement tools or techniques using by the firm

Responses	PDCA	QFD	Failure mode and Effect analysis	Pareto analysis	Histogram	Cause and effect diagram	Flow chart	Scatter diagram	Check sheet	Nominal Group Technique	Statistical control charts	Why-Why Diagram	None
1	√												
2					√	√		√	√		√		
3			√	√	√	√	√						
4							√		√				
5							√						
6		√											
7	√												
8	√					√	√		√				
9									√				
10	√						√						
11	√												
12					√								
13	√		√				√		√				
14							√						
15	√												
16					√		√						
17	√								√				
18	√												
19	√	√											
20	√												
21	√						√		√				
22									√				
23	√					√	√		√				
24	√				√		√		√				
25	√						√		√				
26	√						√		√				

Responses	PDCA	QFD	Failure mode and Effect analysis	Pareto analysis	Histogram	Cause and effect diagram	Flow chart	Scatter diagram	Check sheet	Nominal Group Technique	Statistical control charts	Why-Why Diagram	None
27							√		√				
28	√						√		√				
29					√		√		√				
30					√		√		√				
31	√				√		√		√				
32	√				√	√	√		√				
33	√				√		√		√				
34									√				
35					√		√		√				
36							√		√				
37	√				√		√		√				
38							√		√				
39	√				√				√				
40	√				√		√		√				
41	√				√		√		√				
42				√							√		
43	√								√				
44				√					√				
45							√						
46				√					√				
47				√			√		√				
48	√						√		√				
49	√				√		√		√				
Total	**27**	**2**	**2**	**5**	**16**	**5**	**30**	**1**	**33**	**0**	**2**	**0**	**0**
%	**55.1**	**4.1**	**4.1**	**10.2**	**32.7**	**10.2**	**61.2**	**2.0**	**67.3**	**0.0**	**4.1**	**0.0**	**0.0**

Appendix E

Implementation of TQM elements (Leadership and Continues Improvement) in the Construction of Mega Building Projects in Bahrain

This survey is a complementary questionnaire related to the study of TQM Implementation in construction projects in Bahrain.

In previous survey questionnaire done for this study, Ten Success Factors of TQM implementation were ranked as the most Critical Key Factors that affects the effectiveness of TQM implementation in construction projects.

From your experience and point of view, rate the relationship of the Ten Critical success Factors against Two of TQM elements: Leadership and Process Management, in order to get 100% or 70% or 50% or 20% achievement level of these two elements.

Case study:

A contractor starting a building construction project with total grand cost (BD 1 million), twelve months period of construction.

Assume that you are the project manager and you need to plan for the quality prior to the construction stage. You have to predict the level of critical success factors needed to achieve various levels of implementation for two selected TQM elements (Leadership and Continues improvement).

Leadership

1. Please assess the below Critical Success Factors and rate from 1 to 5 (low to high) in order to get a 100% achievement level in Leadership.

1. Top management's commitment

○1 ○2 ○3 ○4 ○5

2. Understanding of client's requirements and expectations of the project outcome

○1 ○2 ○3 ○4 ○5

3. Planning realistically for time, budget, material and human resources

○1 ○2 ○3 ○4 ○5

4. Quality education and training

○1 ○2 ○3 ○4 ○5

5. Teamwork

○1 ○2 ○3 ○4 ○5

6. Communication between top managers and employees

○1 ○2 ○3 ○4 ○5

7. Measuring customer satisfaction periodically

○1 ○2 ○3 ○4 ○5

8. Process management

○1 ○2 ○3 ○4 ○5

9. Time management

○1 ○2 ○3 ○4 ○5

10. Organizational culture (Shared beliefs and values established by leaders that ultimately shaping employee perceptions, behaviors and understanding).

○1 ○2 ○3 ○4 ○5

---

2. Please assess the below Critical Success Factors and rate from 1 to 5 (low to high) in order to get a 70% achievement level in Leadership.

1. Top management’s commitment

○1 ○2 ○3 ○4 ○5

2. Understanding of client's requirements and expectations of the project outcome

○1 ○2 ○3 ○4 ○5

3. Planning realistically for time, budget, material and human resources

○1 ○2 ○3 ○4 ○5

4. Quality education and training

○1 ○2 ○3 ○4 ○5

5. Teamwork

○1 ○2 ○3 ○4 ○5

6. Communication between top managers and employees

○1 ○2 ○3 ○4 ○5

7. Measuring customer satisfaction periodically

○1 ○2 ○3 ○4 ○5

8. Process management

○1 ○2 ○3 ○4 ○5

9. Time management

○1 ○2 ○3 ○4 ○5

10. Organizational culture

○1 ○2 ○3 ○4 ○5

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3. Please assess the below Critical Success Factors and rate from 1 to 5 (low to high) in order to get a 50% achievement level in Leadership.

1. Top management’s commitment

○1 ○2 ○3 ○4 ○5

2. Understanding of client's requirements and expectations of the project outcome

○1 ○2 ○3 ○4 ○5

3. Planning realistically for time, budget, material and human resources

○1 ○2 ○3 ○4 ○5

4. Quality education and training

○1 ○2 ○3 ○4 ○5

5. Teamwork

○1 ○2 ○3 ○4 ○5

6. Communication between top managers and employees

○1 ○2 ○3 ○4 ○5

7. Measuring customer satisfaction periodically

○1 ○2 ○3 ○4 ○5

8. Process management

○1 ○2 ○3 ○4 ○5

9. Time management

○1 ○2 ○3 ○4 ○5

10. Organizational culture

○1 ○2 ○3 ○4 ○5

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4. Please assess the below Critical Success Factors and rate from 1 to 5 (low to high) in order to get a 20% achievement level in Leadership.

1. Top management’s commitment

○1 ○2 ○3 ○4 ○5

2. Understanding of client's requirements and expectations of the project outcome

○1 ○2 ○3 ○4 ○5

3. Planning realistically for time, budget, material and human resources

○1 ○2 ○3 ○4 ○5

4. Quality education and training

○1 ○2 ○3 ○4 ○5

5. Teamwork

○1 ○2 ○3 ○4 ○5

6. Communication between top managers and employees

○1 ○2 ○3 ○4 ○5

7. Measuring customer satisfaction periodically

○1 ○2 ○3 ○4 ○5

8. Process management

○1 ○2 ○3 ○4 ○5

9. Time management

○1 ○2 ○3 ○4 ○5

10. Organizational culture

○1 ○2 ○3 ○4 ○5

Continuous improvement

1. Please assess the below Critical Success Factors and rate from 1 to 5 (low to high) in order to get a 100% achievement level in Process Management.

1. Top management’s commitment

○1 ○2 ○3 ○4 ○5

2. Understanding of client's requirements and expectations of the project outcome

○1 ○2 ○3 ○4 ○5

3. Planning realistically for time, budget, material and human resources

○1 ○2 ○3 ○4 ○5

4. Quality education and training

○1 ○2 ○3 ○4 ○5

5. Teamwork

○1 ○2 ○3 ○4 ○5

6. Communication between top managers and employees

○1 ○2 ○3 ○4 ○5

7. Measuring customer satisfaction periodically

○1 ○2 ○3 ○4 ○5

8. Process management

○1 ○2 ○3 ○4 ○5

9. Time management

○1 ○2 ○3 ○4 ○5

10. Organizational culture

○1 ○2 ○3 ○4 ○5

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2. Please assess the below Critical Success Factors and rate from 1 to 5 (low to high) in order to get a 70% achievement level in Process Management.

1. Top management’s commitment

○1 ○2 ○3 ○4 ○5

2. Understanding of client's requirements and expectations of the project outcome

○1 ○2 ○3 ○4 ○5

3. Planning realistically for time, budget, material and human resources

○1 ○2 ○3 ○4 ○5

4. Quality education and training

○1 ○2 ○3 ○4 ○5

5. Teamwork

○1 ○2 ○3 ○4 ○5

6. Communication between top managers and employees

○1 ○2 ○3 ○4 ○5

7. Measuring customer satisfaction periodically

○1 ○2 ○3 ○4 ○5

8. Process management

○1 ○2 ○3 ○4 ○5

9. Time management

○1 ○2 ○3 ○4 ○5

10. Organizational culture

○1 ○2 ○3 ○4 ○5

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3. Please assess the below Critical Success Factors and rate from 1 to 5 (low to high) in order to get a 50% achievement level in Process Management.

1. Top management’s commitment

○1 ○2 ○3 ○4 ○5

2. Understanding of client's requirements and expectations of the project outcome

○1 ○2 ○3 ○4 ○5

3. Planning realistically for time, budget, material and human resources

○1 ○2 ○3 ○4 ○5

4. Quality education and training

○1 ○2 ○3 ○4 ○5

5. Teamwork

○1 ○2 ○3 ○4 ○5

6. Communication between top managers and employees

○1 ○2 ○3 ○4 ○5

7. Measuring customer satisfaction periodically

○1 ○2 ○3 ○4 ○5

8. Process management

○1 ○2 ○3 ○4 ○5

9. Time management

○1 ○2 ○3 ○4 ○5

10. Organizational culture

○1 ○2 ○3 ○4 ○5

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4. Please assess the below Critical Success Factors and rate from 1 to 5 (low to high) in order to get a 20% achievement level in Process Management.

1. Top management’s commitment

○1 ○2 ○3 ○4 ○5

2. Understanding of client's requirements and expectations of the project outcome

○1 ○2 ○3 ○4 ○5

3. Planning realistically for time, budget, material and human resources

○1 ○2 ○3 ○4 ○5

4. Quality education and training

○1 ○2 ○3 ○4 ○5

5. Teamwork

○1 ○2 ○3 ○4 ○5

6. Communication between top managers and employees

○1 ○2 ○3 ○4 ○5

7. Measuring customer satisfaction periodically

○1 ○2 ○3 ○4 ○5

8. Process management

○1 ○2 ○3 ○4 ○5

9. Time management

○1 ○2 ○3 ○4 ○5

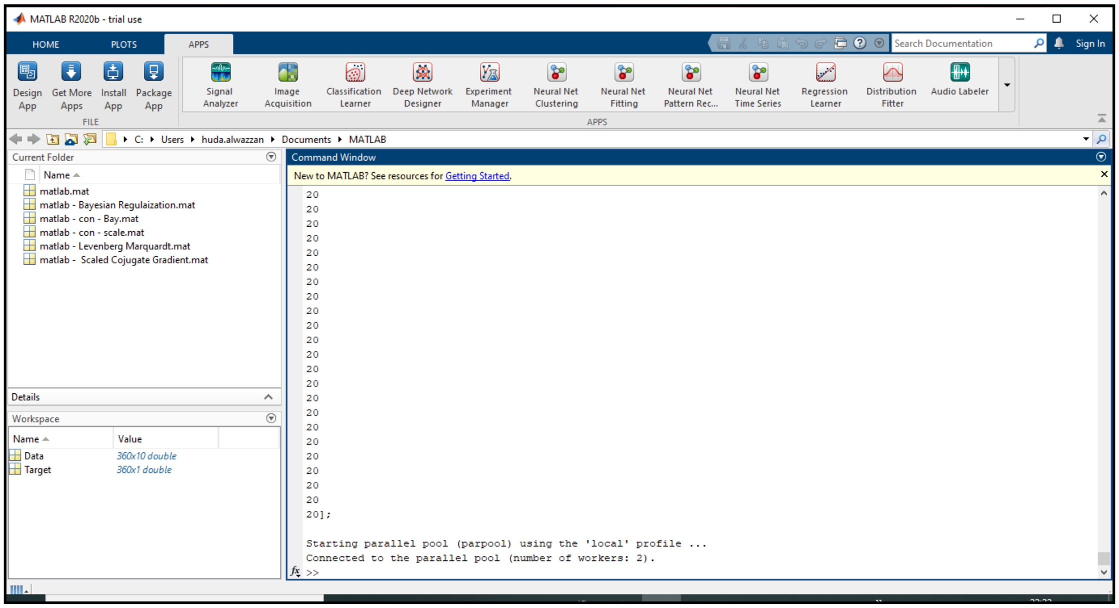
10. Organizational culture

○1 ○2 ○3 ○4 ○5

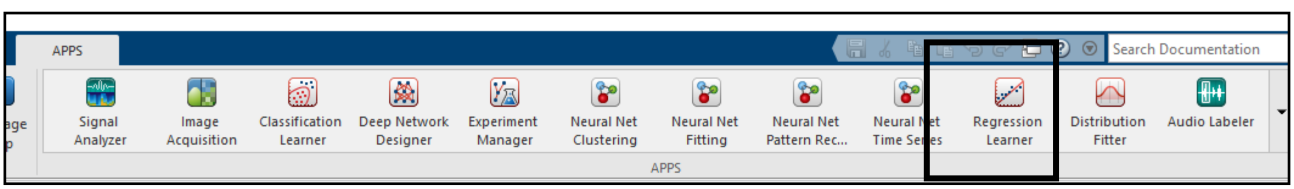
Appendix F

The following steps describe the model formulating process.

1. Enter the Code formulated by Microsoft Excel to the command window.



2. In the Machine Learning group, click on the Apps tab and choose **Regression Learner**.



3. On the dialog box appear on the screen, click **New Session** > **From Workspace.** Select the input from the **Data set Variables** (choose **Data**). Under Responses, select data from the workspace or from file (choose **From workspace**). Under Predictors, use the chick boxes to add or remove predictors. Click on **Add All** to select all the predictors. Choose a **Validation**

method to examine the predictive accuracy of the fitted models. Validation estimates model performance on new data, and helps you choose the best model. Choose a validation scheme before training any models.

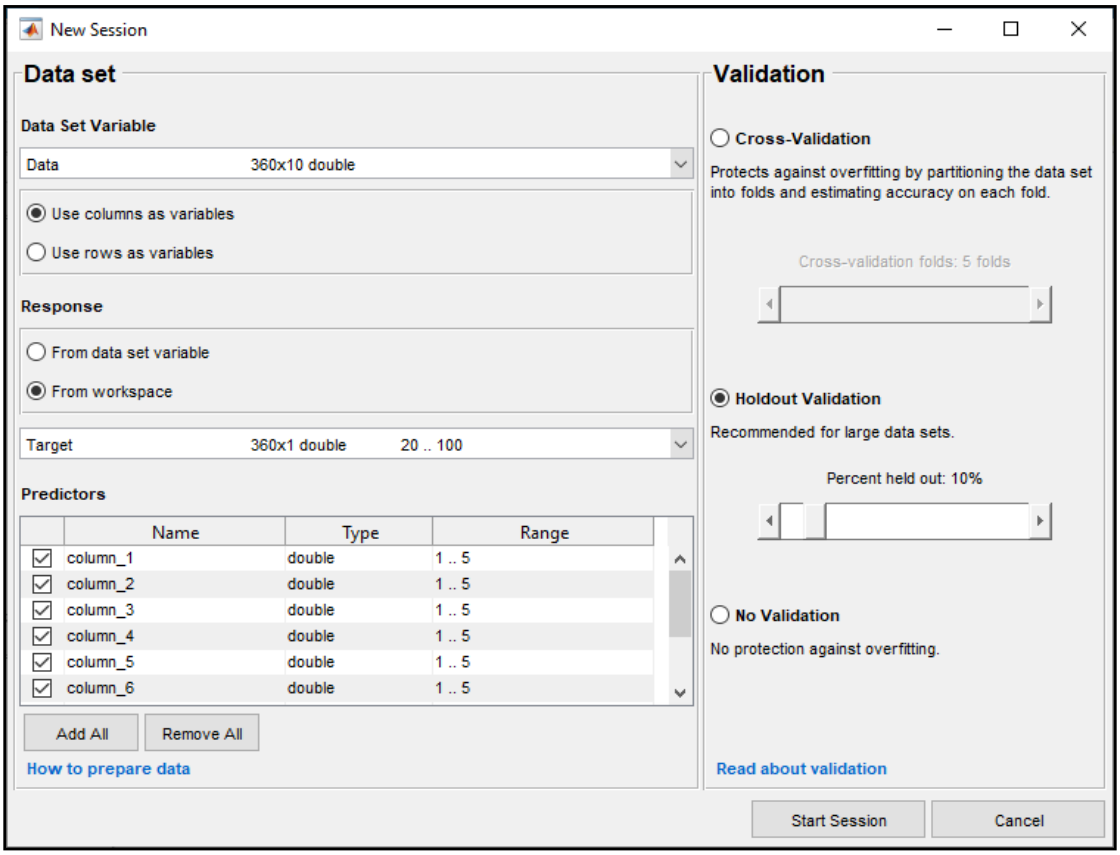
- **Cross-Validation**: Select the number of folds (or divisions) to partition the data set using the slider control.

  If you choose k folds, then the app:

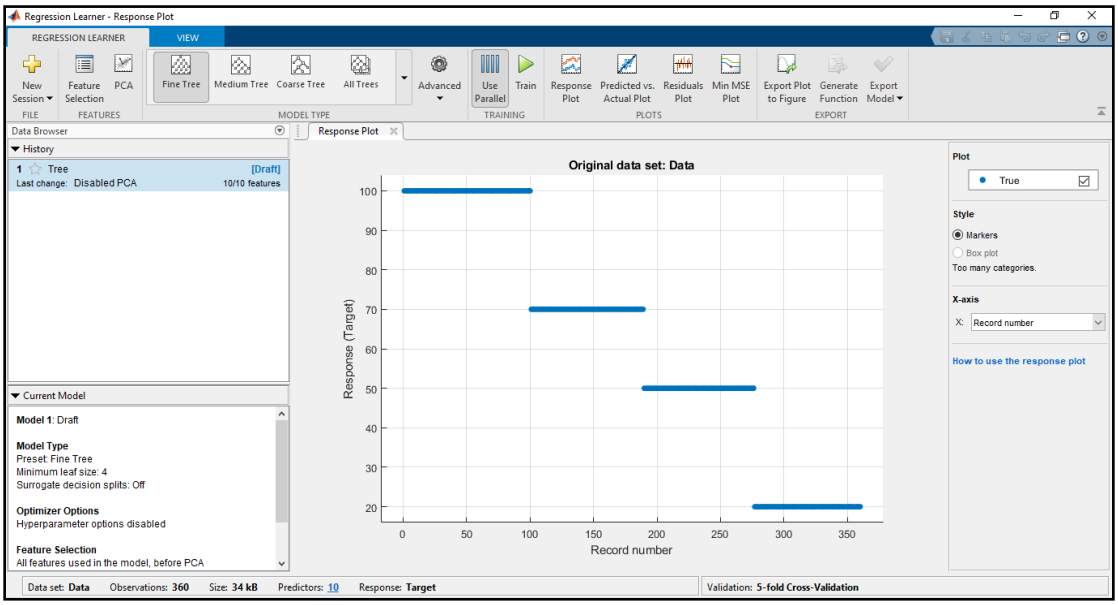
  1. Partitions the data into k disjoint sets or folds
  2. For each fold:
     a. Trains a model using the out-of-fold observations
     b. Assesses model performance using in-fold data
  3. Calculates the average test error over all folds

  This method gives a good estimate of the predictive accuracy of the final model trained using the full data set. The method requires multiple fits, but makes efficient use of all the data, so it works well for small data sets.
- **Holdout Validation**: Select a percentage of the data to use as a validation set using the slider control. The app trains a model on the training set and assesses its performance with the validation set. The model used for validation is based on only a portion of the data, so holdout validation is appropriate only for large data sets. The final model is trained using the full data set.

For this study both validation levels were examined using number of folds range from 2 to 50 folds for Cross-Validation and Percentage of 5 to 50 percent held out.



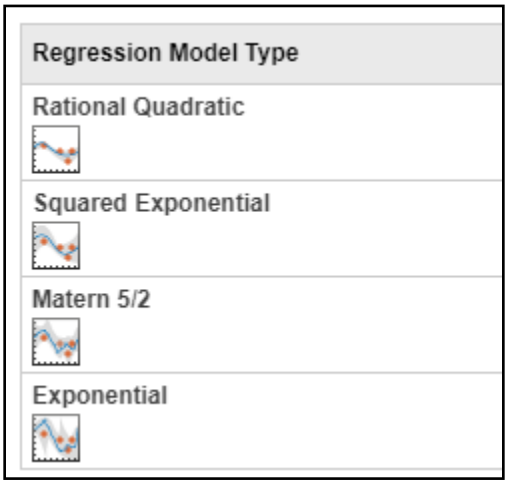
4. Click **Start Session.** The input original data will appear on the screen.



5. On the Regression Learner tab, in the Model Type section, click the arrow to expand the list of regression models. Choose the model type (Choose **Gaussian Process Regression Models)**. One model can be trained at a time or group of models of the same type. To train all models on Gaussian Regression one time, select **All GPR Models.**

   This option trains all the models and present the models that are fast to fit. GPR models are highly accurate, but difficult to interpret.

   Types of Gaussian regression are:

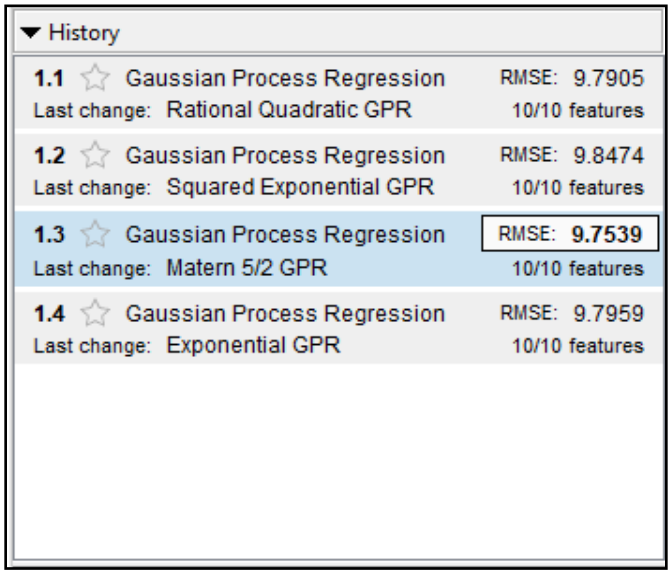


   "In Gaussian process regression, the response is modeled using a probability distribution over a space of functions. The flexibility of the presets in the Model Type gallery is automatically chosen to give a small training error and, simultaneously, protection against over fitting".

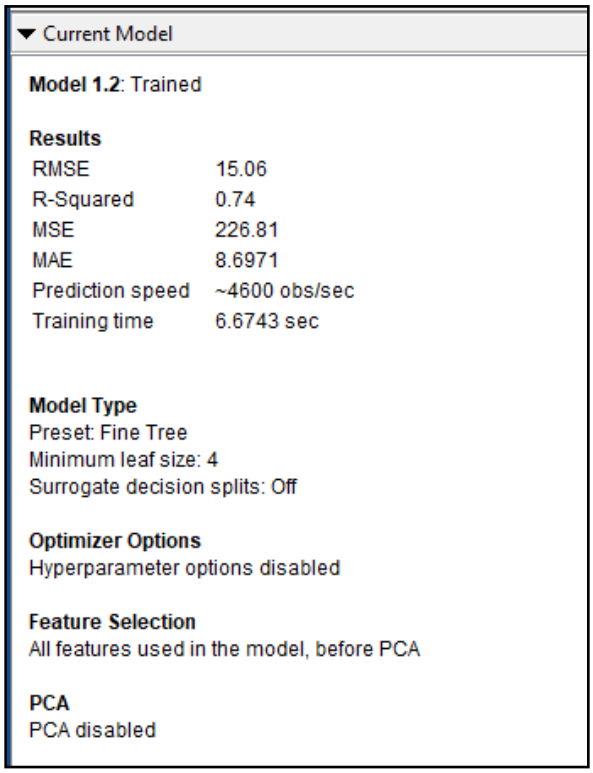
6. Click **Train**.



7. The selected model types appears in the History list. When the model finish training the best **RMSE** score will be highlighted in a box. Examine the RMSE score reported in the History list for each model.



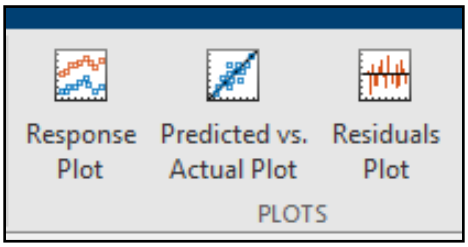
8. To view the model statistics, click on the model from the models listed in the History list and the statistics related to the selected model will appear on the **Current Model**.



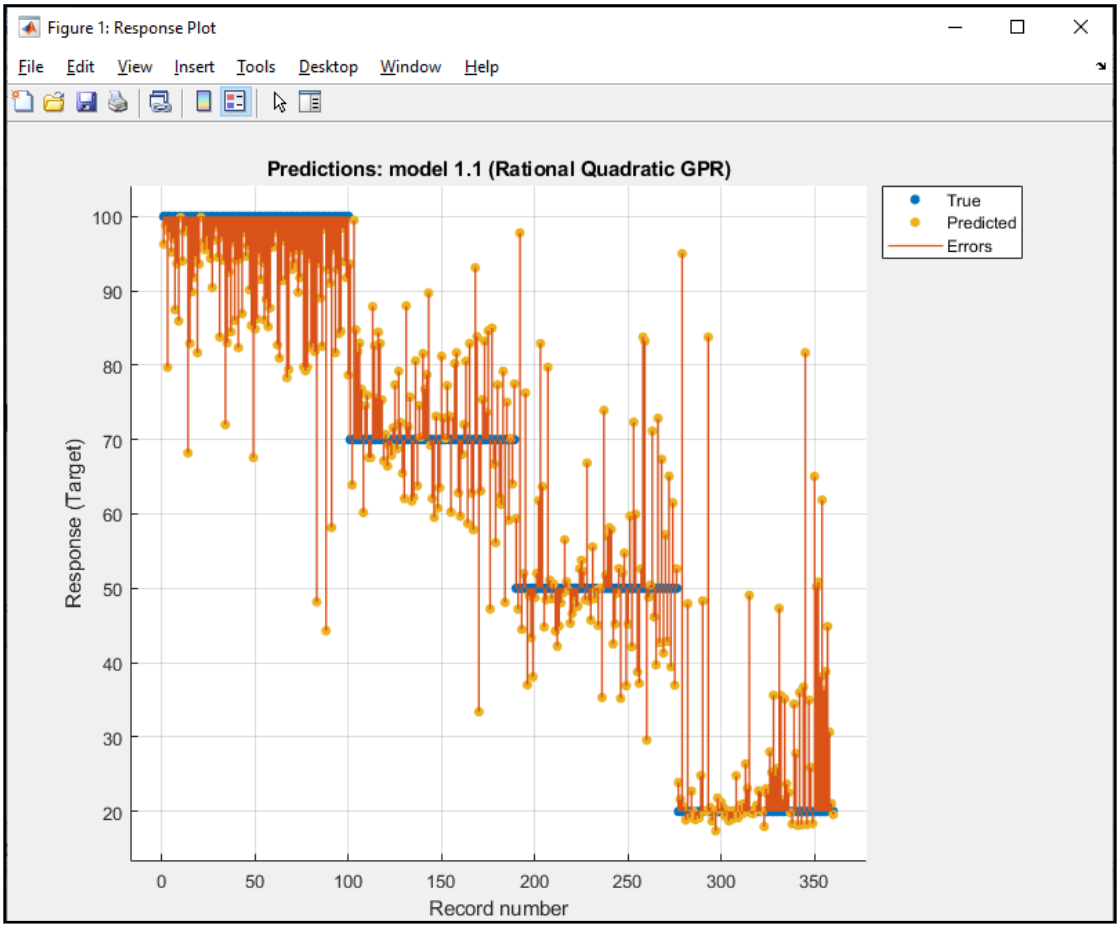
Model Statistics

Statistic	Description	Tip
RMSE	Root mean square error. The RMSE is always positive and its units match the units of your response.	Look for smaller values of the RMSE.
R-Squared	Coefficient of determination. R-squared is always smaller than 1 and usually larger than 0. It compares the trained model with the model where the response is constant and equals the mean of the training response. If your model is worse than this constant model, then R-Squared is negative.	Look for an R-Squared close to 1.
MSE	Mean squared error. The MSE is the square of the RMSE.	Look for smaller values of the MSE.
MAE	Mean absolute error. The MAE is always positive and similar to the RMSE, but less sensitive to outliers.	Look for smaller values of the MAE.

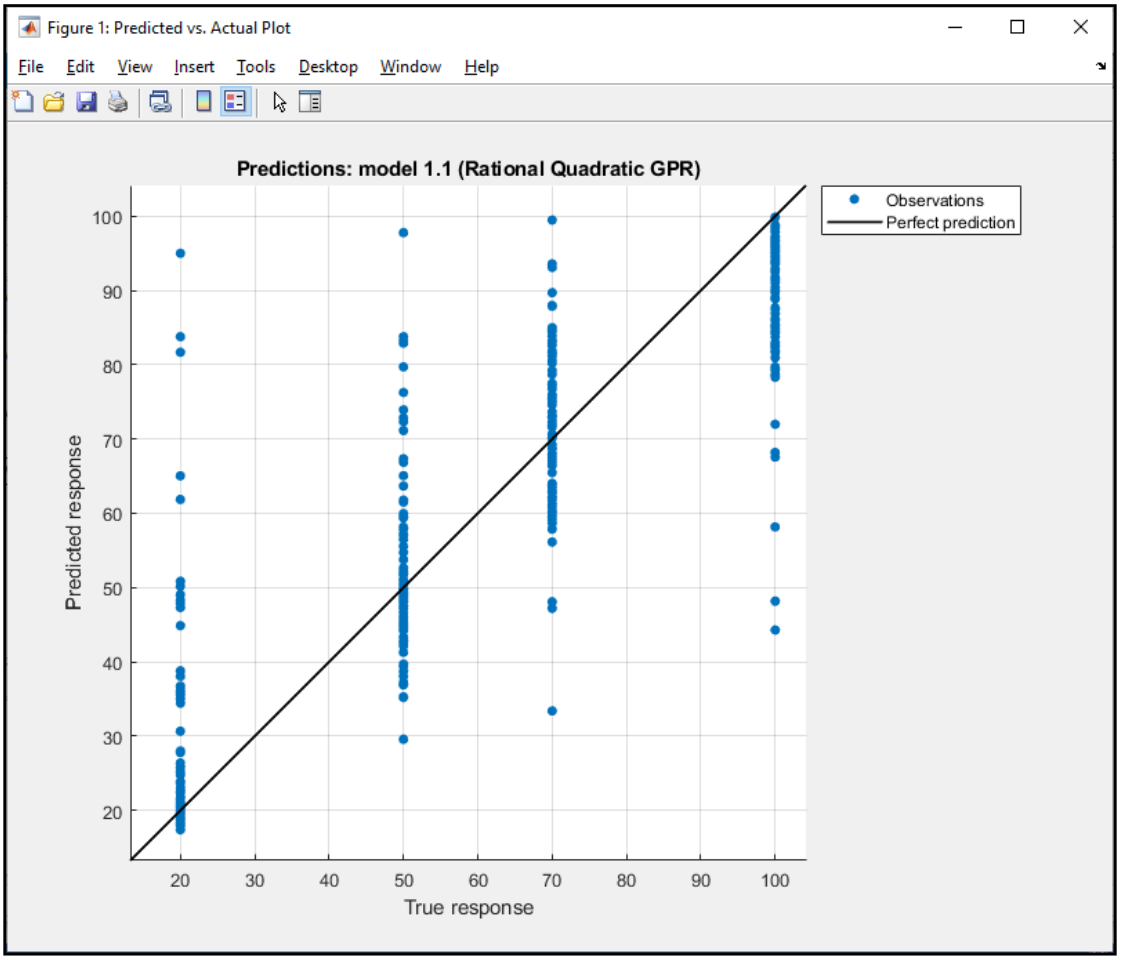
9. Inspect the results in the plots that the program generates automatically and compare the model performance.



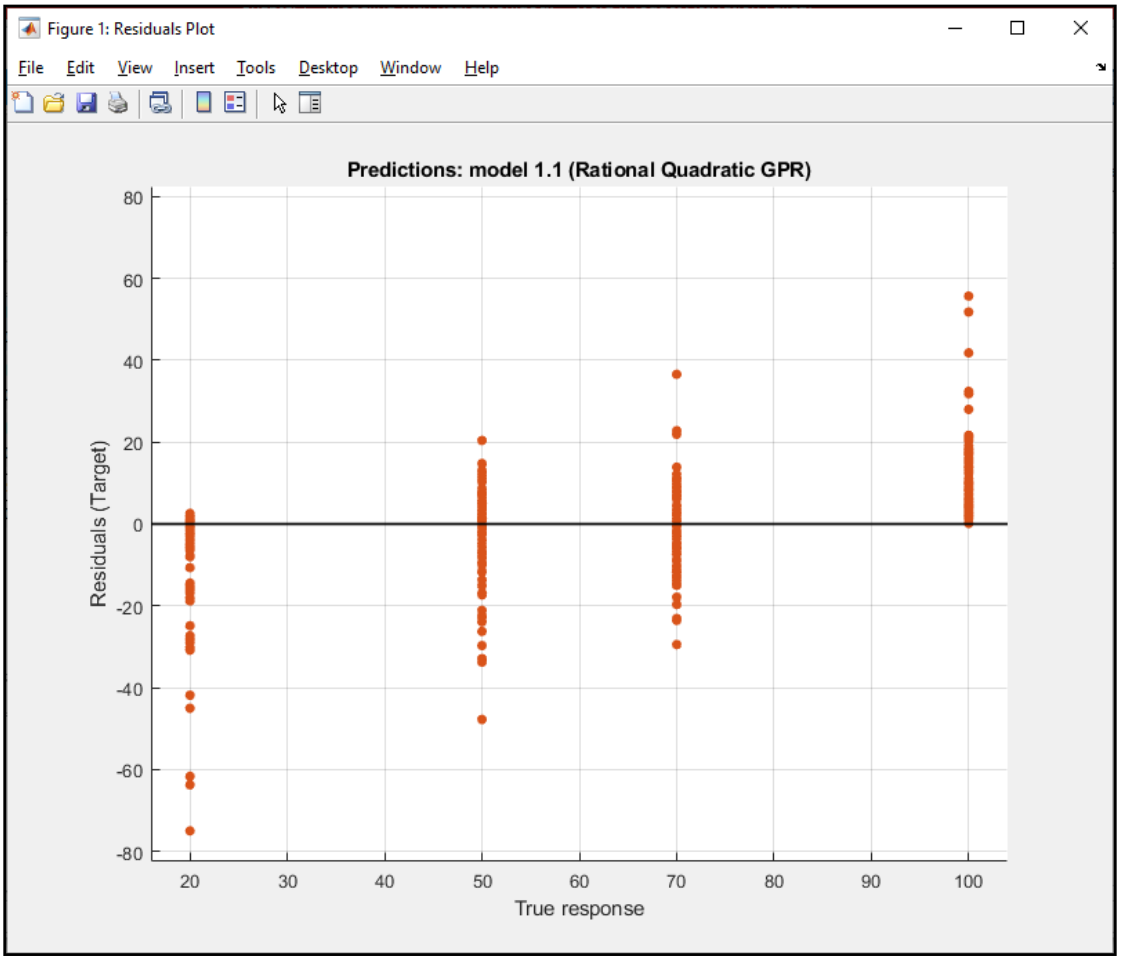
a. **Response Plot**: show prediction errors presented as vertical lines between the predicted and true responses.



b. **Predicted vs. Actual Response**: “the predicted response of the generated model is plotted against the actual response. A perfect regression model has a predicted response equal to the true response, so all the points lie on a diagonal line. The vertical distance from the line to any point is the error of the prediction for that point. A good model has small errors, and so the predictions are scattered near the line”.

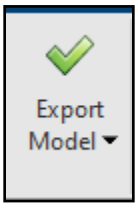


c. **Residuals Plot:** it displays the difference between the predicted and true responses. Usually a good model has residuals scattered roughly symmetrically around 0.

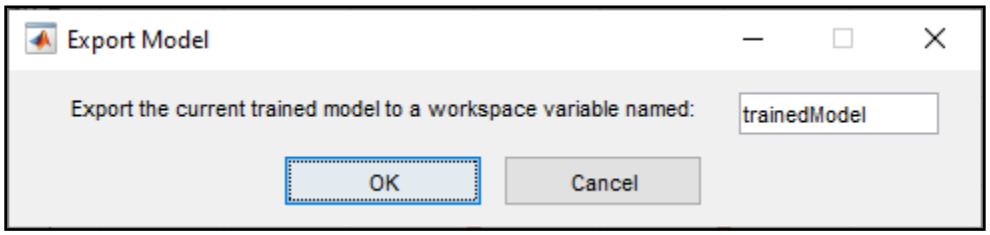


10. Select the best model in the History list and then try to improve the model further by changing the validation settings.

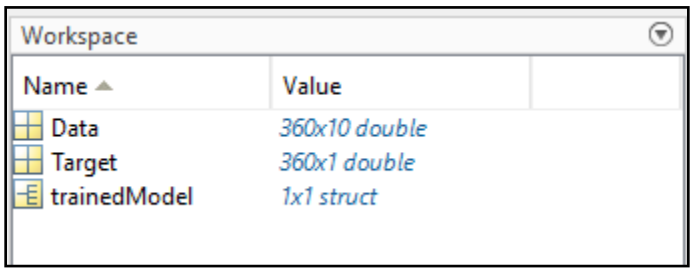
11. Export the best model to the workspace as a structure containing a regression model object.



Export Model dialog box will appear on the screen, edit the name of the exported variable. Then, click OK. The default name for the exported model is **trained Model**.



The new variable (for example, trainedModel) will appear in the workspace.



12. After exporting the model, the app displays information about the exported model in the command window. The trainedModel structure will be used to make predictions for new data, X:

    yfit = trainedModel.predictFcn(X)

    where trained Model is the name of the exported variable.

To make predictions on a new predictor column matrix, X, use:
yfit = c.predictFcn(X) replacing "c" with the name of the variable that is this struct, e.g. "trainedModel". X must contain exactly 10 columns because this model was trained using 10 predictors. X must contain only predictor columns in exactly the same order and format as your training data. Do not include the response column or any columns you did not import into the app.

13. To use the model generated to test the data, supply the data X with the same format and data type as the training data used in the app (table or matrix). The format of the variables must match the original input data, in the same order and format.

خلال تفويضهم السلطة لبدء تغييرات في الأنشطة المتعلقة بوظيفتهم لتحقيق المزيد من التحسينات على المستوى التشغيلي. علاوة على ذلك، توصي الدراسة بتخصيص تمويل كافٍ من الميزانية لدعم وتمويل التحسينات المطلوبة.

نتيجة للدراسة، تم تقديم نموذج التنبؤ لمساعدة المقاولين على التنبؤ بمستوى تنفيذ إدارة الجودة الشاملة لتقييم العملية وتحسينها لضمان التنفيذ الفعال والناجح لإدارة الجودة الشاملة في القطاع الإنشائي للمشاريع الضخمة في مملكة البحرين.

ملخص البحث

يهدف هذا البحث إلى دراسة العوامل الرئيسية لإدارة الجودة الشاملة المؤدية إلى التنفيذ الناجح لها في قطاع التعمير، وخصوصاً فيما يتعلق بمشاريع البناء الضخمة في مملكة البحرين. تتبع هذه الدراسة نهج البحث الوصفي من خلال توزيع استبيانين لاستطلاع الرأي؛ استبيان إداري موجه إلى 21 مديراً بشركات الإنشاء ذات الدرجة الأولى بينما تم توزيع استبيان تشغيلي على 49 عاملاً من المستوى التشغيلي لهذه الشركات بما في ذلك مهندس / فني / مفتش موقع / مسؤول جودة. كشفت النتائج أن هناك علاقة إيجابية ذات دلالة إحصائية بين تنفيذ إدارة الجودة الشاملة في شركات البناء العملاقة التي شملتها الدراسة في مملكة البحرين وعوامل النجاح التالية: القيادة، سياسة الشركة والاستراتيجية، التحسين المستمر، القياس والاستجابة، إدارة جودة المقاولين الفرعيين والموردين، إدارة العمليات، إدارة الموارد، التعليم والتدريب، وبيئة العمل والثقافة. كما أظهرت النتائج أن هناك تأثير إيجابي كبير لعوامل النجاح على تطبيق إدارة الجودة الشاملة في هذه الشركات.

وجدت النتائج أن عوامل سياسة الشركة واستراتيجيتها والتحسين المستمر والقيادة وإدارة الموارد وبيئة العمل والثقافة، هي العوامل الأكثر تأثيرًا على نجاح تنفيذ إدارة الجودة الشاملة في الشركات التي تم دراستها. وكشفت الدراسة أن هذه الشركات تفتقر إلى الاستجابة الديناميكية للتغيرات السريعة وعدم الاستقرار في بيئة الأعمال. بالإضافة إلى ذلك، تم التوصل إلى أن هذه الشركات تعتمد بشكل كبير على موظفيها الذين يتعاملون مع المهام الموكلة إليهم ويقومون بإجراء التحسينات اللازمة وحل مشاكل العمل بما يرونه مناسباً، حيث لا يوجد فريق تحسين وفقًا للمخطط التنظيمي لهذه الشركات. علاوةً على ذلك، لا يتمتع بعض الموظفين بقدرٍ مُرضٍ من الاستقلالية التي تُمنح من قبل المدراء لدمج التغييرات في المهام التي ينجزونها. بالإضافة إلى ذلك، لم تكن الموارد المالية المقدمة لدعم أنشطة التحسين كافية، وبالتالي تم استنتاج أن ميزانية هذه الشركات مخصصه لإنجاز مشاريع البناء فقط، بينما لا يوجد تمويل مخصص للتعامل مع أي تحسينات مطلوبة في هذه المشاريع.

أوصت الدراسة بمراجعة سياسات الشركات الإنشائية لتمكينها من التعامل بشكل استباقي مع الموارد المتاحة لتواكب المتغيرات، ودمج ديناميكية العمل مع عملية صنع القرار الخاصة بهم لمعالجة المشاكل والعراقيل التي تنطوي عليها بيئة العمل. كما توصي بمراجعة السياسات والممارسات ذات الصلة بعملية التحسين وتشجيع الموظفين على إبداء الرأي واقتراح الأفكار الجديدة التي قد تعزز من عملية التطوير. بالإضافة إلى ذلك، أهمية تمكين الموظفين من

جامعة البحرين

كلية الهندسة الميكانيكية

قسم الهندسة

تقييم تنفيذ إدارة الجودة الشاملة في إنشاء مشاريع البناء الضخمة في البحرين

أطروحة مقدمة كجزء من متطلبات الحصول على درجة الماجستير في برنامج الإدارة الهندسية

إعـــــداد

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يناير/2022