IMPACT OF ISO 9001 BASED QUALITY MANAGEMENT SYSTEM (QMS)

ON

PROJECT PERFORMANCE OF STATE SECTOR CONSTRUCTION ORGANIZATIONS IN SRI LANKA

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"This dissertation was submitted to the Department of Civil Engineering of the University of Moratuwa in partial fulfilment of the requirements for the Master of Science in Construction Project Management"

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DECLARATION

I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any university to the best of my knowledge and believe it does not contain any material previously published, written or orally communicated by another person or myself except where due reference is made in the text. I also hereby give consent for my dissertation, if accepted, to be made available for photocopying and for inter library loans, and for the title and summary to be available to outside organizations.

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Finally, I wish to express my thanks to the respondents of the questionnaire who were very supportive in providing the essential primary data and feedbacks for this research.

I hope that the findings of this research will be beneficial to Project Management discipline and it will deliver insights for further examination in and around the topic.

ABSTRACT

Quality Management System (QMS) provides generic guidance and requirements for establishing organizational quality management policy and procedure, to increase customer satisfaction by reducing cost and increasing productivity. Therefore QMS manages organizational survival by beating the competition in the market. Especially, in the construction industry, QMS can assist organizations to successfully achieve their organizational goals as well as project objectives by satisfying customer needs in all the phases. The main aim of this study was to **evaluate the impact of ISO 9001 based QMS on project performance of State sector organizations in Sri Lanka**. For this purpose, an in-depth literature review was conducted from different books, journals, and websites to get a better understanding of QMS, identify the main characteristics of the vital parts of construction projects and identify the barriers of effective implementation of QMS. Subsequently, a questionnaire was designed based on previous studies and then distributed randomly among the 80 managerial level employees to collect data. Finally, data analysis was conducted using descriptive statistics to find the result and conclusion. The findings have shown that the implementation of QMS can be affected mostly on customer's satisfaction, followed by triple constraints respectively time cost and scope.

Key Words: Quality, Construction, Quality Management Systems, ISO 9001

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ABBREVIATIONS

ISO	: International Organizations for Standardization
QMS	: Quality Management System
PMI	: Project Management Institute
PMBOK	: Project Management Body of Knowledge
CECB	: Central Engineering Consultancy Bureau
SEC	: State Engineering corporation
SD & CC	: State Development & Construction Corporation
CIDA	: Construction Industry Development Authority

CHAPTER 1: INTRODUCTION

1.1 Background

The research topic "Evaluate the Effectiveness of ISO 9001 based Quality Management System (QMS) on construction projects of State Sector Construction Organizations in Sri Lanka" has three key terms, which give specific meaning to the topic.

1. ISO 9001 based quality management system
2. Construction project management
3. State Sector Construction Organizations

To understand the topic, it is better to understand the key terms in the topic.

1.1.1 ISO 9001 based quality management system

A **Quality Management System** (QMS) is a set of policies, processes and procedures required for planning and execution (production/development/service) in the core business area of an organization (i.e., areas that can impact the organization's ability to meet customer requirements). ISO 9001 is an example of a Quality Management System. (Requirements ISO: 2015)

ISO (International Organization for Standardization) is the world's largest developer of voluntary International Standards. International Standards give state of the art specifications for products, services and good practice, helping to make industry more efficient and effective. Developed through global consensus, they help to break down barriers to international trade.

International Organization for Standardization (ISO) has published international management system standards on various subjects such as ISO 9001:2008 (Requirements for a Quality Management System), ISO 14001:2004 (Requirements for an Environment Management System), Food safety standard ISO 22000:2005, Information Security Management Standard (ISO 27001:2005), etc. These standards are generically defined to suit any organization in the world regardless of their size, scope and location. (Requirements ISO, 2015)

Organizations can decide the individual standards for implementation as well as Certification bodies. The number of organizations who are certified with ISO have been increased tremendously within last decade. This has led organizations to forget the main aim of implementing ISO within the organization and use as a marketing tool. Therefore, organizations can't touch ISO core values and optimum benefits.

Recently, Sri Lankan organizations tend to go for ISO certification than early to achieve various objectives, such as improve the quality of the process, for better customer satisfaction and manage the reputation in order to face the rivalry among competitors. There are several ISO certifying authorities in Sri Lanka such as SLSI, SGC, DNV, IRS, MOODY etc. Except SLSI all the other certification bodies are based on foreign countries.

1.1.2 Construction project management

Successful project management can be defined as having achieved the project objectives as on time, within cost, quality (scope) to meet the client's requirements. (Kerzner, 2010). Quality is the most significant factor in the success of construction projects. Moreover, many reports have criticized the construction industry, especially in terms of productivity, quality and quality system(Ali and Rahmat, 2010), and the majority of project managers focus on the cost and time instead of quality for construction projects, but the scholars emphasize more attention should be towards quality(Mane and Patil, 2015). Nowadays, quality has not just implicated on products and services in the organizations, it can be related to the process, systems, and management as well. Quality of construction; project is a general philosophy by which process are carried in a total quality infrastructure (Alberto, 2011). The total quality infrastructure consists of several key pieces.

1.1.3 State Sector Construction Organizations

For this study select the state sector construction industry, state sector Constructions industry play an important role for development of Sri Lanka. The contribution of Construction industry for Gross Domestic Production (GDP) has significant improvement during last few years. Further construction Industry provide significantly high number of job opportunities for Sri Lankan work force.

The Sri Lankan state sector organizations are CECB (Central Engineering Consultancy Bureau), SEC (State Engineering Corporation) and SD&CC (State Development and Construction Corporation). The majority of the state sector construction companies face many challenges and problems, such as delay and cost overrun in complementing their projects in Sri Lanka.

1.2 Problem Identification

According to the International Standard Organization there are many benefits form the ISO 9001 Standard. As per the www.ISO9001.com Not only for the organization but also for the customers having so many benefits as below

Some of the benefits to Organization:

1. Provides senior management with an efficient management process
2. Sets out areas of responsibility across the organization
3. Mandatory if you want to tender for some public sector work
4. Communicates a positive message to staff and customers
5. Identifies and encourages more efficient and time saving processes
6. Highlights deficiencies
7. Reduces your costs
8. Provides continuous assessment and improvement
9. Marketing opportunities

Some of the benefits to customers:

1. Improved quality and service
2. Delivery on time
3. Right first time attitude
4. Fewer returned products and complaints
5. Independent audit demonstrates commitment to quality

ISO 9001 provides basic guidelines to organization to progress from the stage of "Minimum Compliance" to "Consistent performance" so as to reach its ultimate aim of operational excellence and Business Excellence, through Quality Management System.

Construction Industry Development Authority (CIDA) made it compulsory to obtain ISO 9001 for grade C3 and above construction organizations. Consequently, because of CIDA requirement all construction companies in that category worked to get the ISO 9001 certification. Moreover, recent years the ISO market had become highly competitive because of the growing number of clients, certification bodies and consultants. ISO 9001 market in Sri Lankan construction industry has been drenched and some organizations misused flexible structure of the ISO 9001 Standard to get the certification quickly without actually deserving it.

During last 10 years ISO consultancy market became highly competitive because more that 10 new certifying agencies were entered in to operations other than the freelance consultants. Therefore, consultancy firms as well as consultants were under pressure to survive in the market. Since all three state sector construction organizations are ISO certified, with the above explained situation become a cause for initiate a study on the effectiveness of certified organizations. Currently, Rapid increase can be seen in the number of ISO certified companies in Sri Lanka by making ISO 9001 as most popular standard.

Mainly Certification body and external consultants have been involved as external parties for implementation of ISO standards. Employees and Managers have been involved as internal parties for implementation and certification process of ISO. Therefore, these parties are directly responsible for effectiveness of these standards in relevant organization.

This study focused on the ISO 9001 quality management system practices and its impact to the organization performance in state sector construction organizations in Sri Lanka. There is an immense requirement of proper implementation of the ISO 9001 based Quality Management System because improper implementation of ISO 9001 can lead to reduce the credibility of the standard. Moreover, some local and international organizations have an impression that ISO 9001 is just a paper qualification and as something which does not improve organizational performance.

This study provide a framework to measure effective ISO implementation impact to organization performance.

There are very few attempt to investigate about effect of ISO 9001 for Organizations in Sri Lanka. M. C. Thilakarathne and S. K. C. Chithrangani have done an Analysis of Managerial Attitudes towards ISO 9001 Quality Management System Introduction and Implementation Process in Sri Lanka.

Table: 1 Summary of understanding the purposes of ISO certification.

Purposes of selecting ISO 9001:2008	**Certified (N=32)**		
	Mean [a]	**SD[b]**	**Rank**
To establish a consistent documentation	3.44	1.78	1
A means of guaranteeing high grade	3.38	2.51	2
A new name for not-so-new management	3.31	1.40	3
Making the customer the focus of all business	2.78	1.79	4
Continuous improvement through problem	2.59	1.58	5
To establish a quality/formal system]	2.53	1.34	6

Notes: Mean [a] - The mean score is based on participants' level of agreement with each statement on a scale of 1 = strongly disagree to 5 = strongly agree. A mean score above 4 indicates high, between 3 and 4 indicates moderate and a score less than 3 indicates a low level of agreement. SD [b] = standard deviation

In this study they have tested about perceived benefits from implementing ISO 9001:2008 in companies certified for ISO 9001 Quality Management System in Sri Lanka. According to study out of 16 parameters 7 parameters got high marks while other 9 received low and medium ranking.

Table 2: Perceived benefits from implementing ISO 9001:2008 certified companies in Sri Lanka. (From M. C. Thilakarathne and S. K. C. Chithrangani study)

Rank	**Parameter**	**Mean**	**SD**	**Ranking Level**
1	Customer satisfaction	2.84	0.59	High
2	Increases quality awareness	2.75	0.54	High
3	Improves employee productivity	2.75	0.54	High
4	Helps quality Management	2.75	0.55	High
5	Improves the efficiency of the quality system	2.69	0.44	High

6	Improves product/service quality	2.66	0.61	High
7	Product development tool	2.63	0.57	High
8	Promotion tool	2.59	0.40	Medium
9	Reduces costs	2.56	0.42	Medium
10	Improves employee motivation	2.56	0.41	Medium
11	Helps supplier selection	2.53	0.43	Medium
12	Improves employee relations	2.50	0.50	Medium
13	Improves export potential	2.49	0.50	Medium
14	Improves public relations	2.47	0.50	Medium
15	Improves documentation	2.47	0.49	Low
16	Reduces production time	2.38	0.53	Low

Further M. C. Thilakarathne and S. K. C. Chithrangani have concluded the study with below Conclusion.

"Implementation of ISO 9001: 2008 is a tool for understanding products and processes, however by itself will not solve existing problems or guarantee quality. Therefore, in order to achieve the true commercial values associated with it, it should be made consistent with organization's strategic decisions. This refers to using the standard as a foundation for a much broader system such as total quality management.

Furthermore organizations certified for ISO 9001: 2008 could more focus on the continuous quality improvement in order to serve the patrons in different and delightful manner in the long run.

The credibility of the ISO 9001: 2008 certificate is crucial in today's context as many certification bodies are profit oriented and focusing on the business, hence possessing of an ISO 9001: 2008 certificate will not always guarantee effective implementation and continual improvements in the system. This could be a one of the major limitations of the study.

Since there are more certification bodies exist in Sri Lanka including, national, multinational and local certification bodies, it is vital to investigate the credibility of accredited ISO 9001: 2008 certification offered by each certification bodies. Therefore future research areas shall focus on credibility, efficiency and effectiveness of issuing ISO 9001: 2008 quality management systems certifications by established certification bodies in Sri Lanka"

Quote from Mr. P. M. C. Thilakarathne's and S. K. C. Chithrangani's study

1.2.1 Definition of Research Problem

ISO 9001:2015 is a general guideline and it's include ten main clauses. How these clauses implement in the organizations cause to effect performances of the Organization. If an Organization implement these clauses effectively it may help to improve company performance. So in this paper study "what factors of ISO 9001 QMS contribute for organization performance?"

ISO 9001:2015 provides general guidelines which includes ten main clauses. If this clauses implement properly and effectively within an organization it may help to improve company performance. SO, it's important to measure the effectiveness of ISO on construction projects as well as identify the barriers of effective implementation of QMS.

1.3 Research Objectives

01 To identify the key factors of ISO 9001 based QMS which contribute for project success which leads to organization success.

02 To explore and identify the impact of ISO 9001 based QMS factors on construction projects in state sector construction organizations.

03 To examine and identify the significance of implementation of ISO 9001 based QMS on the key project performance indicators (Scope/Quality, Time, Cost & Client's Satisfaction) of project management.

1.4 Limitations of the Study

Study about ISO 9001:2015 implementation and its impact on organization performance at construction companies have limitations.

- Limited only to state sector construction organizations because such research which has done for the government sector was not available.
- Respondent for the survey may be not to give honest answers to the questions in the questionnaire, because some time they have a feeling that giving honest answers badly affect to the Organization.

- The understanding of questions in the questionnaire may be an issue for some of the respondent, may not realize the question properly to give a correct answer.

- Lack of respond for the Survey, because this study targeting Management level participants so with their busy work schedules less attention for fill the questionnaire.

- This is not a common topic use for researches so it's difficult to find literature about this especially in Sri Lanka.

- There is a limited time frame to complete the study. Because of that not possible to gathers data from a big sample.

1.5 Research Methodology

In this study, questionnaire was used to collect data from the target group of respondents. The designed questionnaire let the respondents to provide their opinion based on their experiences. Likert-scales are proper and widely used for opinion management. Participants in the study were managerial level employees (Project Managers, Engineers and Quantity Surveyors) of state sector construction organizations namely Central Engineering Consultancy Bureau (CECB), State Engineering Corporation (SEC) and State Development & Construction Corporation (SD & CC).

Data analysis was based on descriptive statistics and MS Excel was used to analyze data. Descriptive statistics provide simple summaries about the sample and about the observations that have been made. In the business world, descriptive statistics provides a useful summary of many types of data.

1.6 Structure of the report

Chapter 1 - Introduction

This chapter introduces the Background of ISO standards and implementation of ISO 9001 in Construction Industry in Sri Lanka. The research problem statement, research questions, research objectives, limitations of the study also discussed.

Chapter 2 - Literature Review

In this chapter the researcher examines in depth the relevant literature including books, journals, articles, by prominent scholars and academics who has done extensive research on ISO 9000 implementation and impact on organization performance. The researcher examines the most relevant research findings and the variables are identified for the researchers own survey.

Chapter 3 – Research methodology

This chapter describes the research methodology adopted by the researcher for the research. Conceptual framework, hypothesis, operationalization of variables, research design, sample design, sources of data collection are discussed.

Chapter 4 - Data Presentation and Analysis

The findings of this survey is analyzed and presented in this chapter. The researcher interprets the relationship of the independent and dependent variables and presents the findings according to the hypothesis.

Chapter 5 - Conclusion and Recommendation

The researcher will summarize the study and will highlight the Conclusions and recommendations of the study done on implementation and impact on organization performance. Also the researcher will identify and present areas for further research.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction to Quality Management

According to PMI, 2013, Project Quality Management comprises the processes of conducting quality management planning, performing quality assurance and controlling quality on a project. The objectives of project quality management are to ensure that project requirements, including product requirements are met and validated. Project quality management includes the following processes as shown in Figure 1.

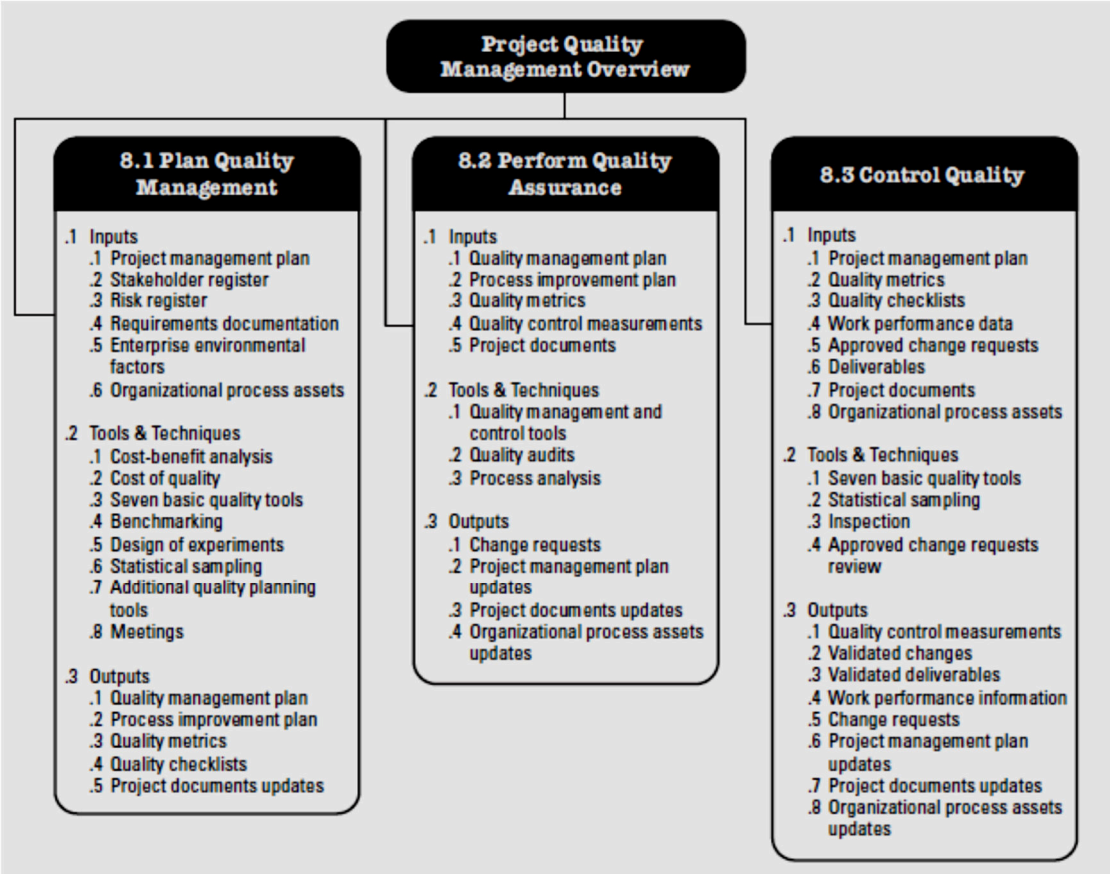


Figure 1: Project Quality Management Overview adopted from PMI, 2013

2.1.1 Plan Quality Management

Plan quality management is the process of defining how to conduct quality management activities for a project. Cautious and clear planning improves the probability of success for the five other quality management processes. Quality planning plays a very major role in determining and providing adequate resources and time for the quality management activities. It will create a basis for assessing quality in a project. The plan quality management process should begin as the project kicks off and should be finished early during project planning (PMI, 2013). Plan quality management includes the following processes as shown in Figure 2.

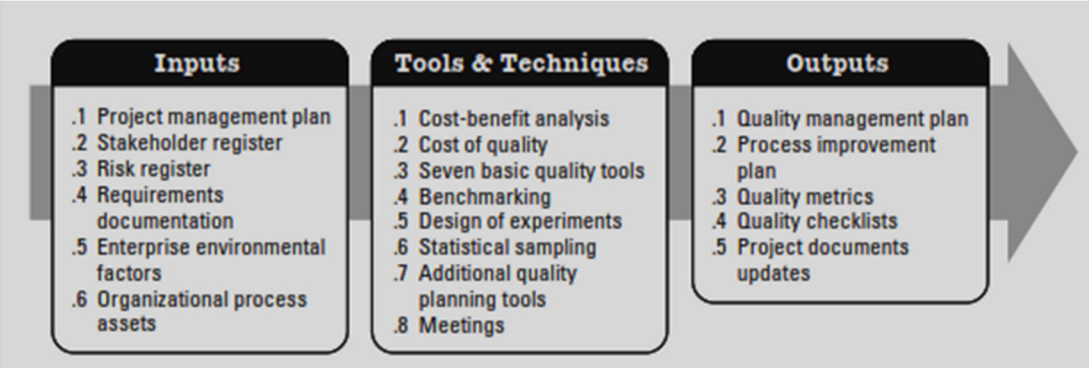


Figure 2: Plan Quality Management Process adopted from PMI, 2013

2.1.2 Perform Quality Assurance

Perform Quality Assurance is the process of auditing the quality requirements and the results from quality control measurements to ensure that appropriate quality standards and operational definitions are used. The key benefit of this process is that it facilitates the improvement of quality processes. The following Figure 3 shows the inputs, tools and techniques, and outputs which are used for quality assurance process.

Figure 3: Quality Assurance Process adopted from PMI, 2013

2.1.3 Control Quality

Control Quality is the process of monitoring and recording results of executing the quality activities to assess performance and recommend necessary changes. The key benefits of this process include: (1) identifying the causes of poor process or product quality and recommending and/or taking action to eliminate them; and (2) validating that project deliverables and work meet the requirements specified by key stakeholders necessary for final acceptance. The following Figure 4 shows the inputs, tools and techniques, and outputs which are used for quality control process.

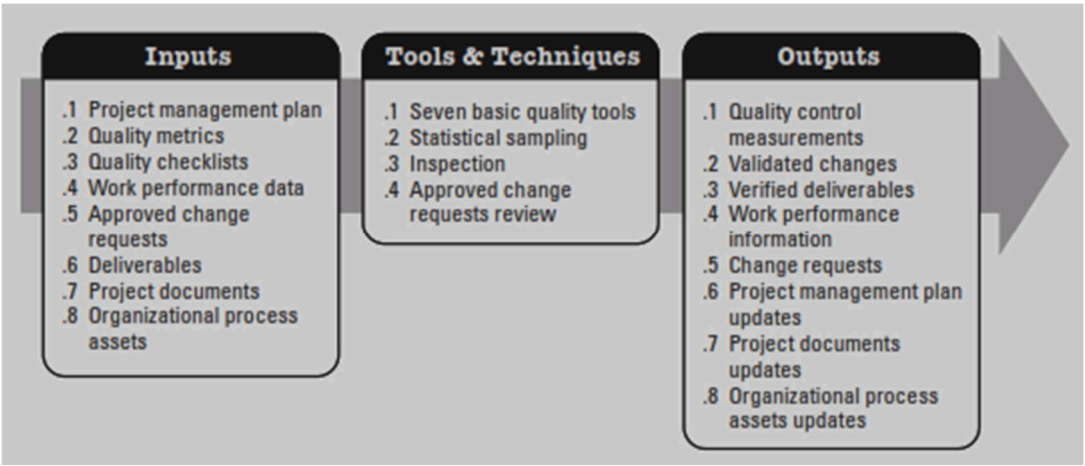


Figure 4: Quality Control Process adopted from PMI, 2013

2.2 Overview of QMS (ISO 9000 family)

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). Quality system was introduced by ISO on 15, March 1987. ISO is compatible with proprietary approaches to quality management such as those recommended by Deming, Juran, Crosby, and non-proprietary approaches such as TQM, Lean Six Sigma, FMEA, COQ, and other continuous improvement techniques (PMI, 2008). Successful implementation of QMS is to take it as a strategic decision for the organization. The purpose of quality management system can be namely such as reducing possible errors of all phases of projects by proper control, finding faults/errors soon, measuring to avoid repeated mistakes, and determining and initiating corrective action/preventive measures (Aized, 2012). According to the latest survey of ISO (2014), 1,609,294 ISO certificates were issued, and the majority of them were belonged to QMS standard or 1,138,155 ISO 9001 certificates issued that met the requirements of QMS under external audit of third-party or Certification Body (UNIDO, 2012). Approximately, 1600 ISO 9001 certificates issued for different industries in the Philippines by 2014.

ISO (technical committee ISO/TC 176) has been published five editions for ISO 9000 certification. The ISO 9000:1987 was included three standards for quality assurance: ISO 9001, ISO 9002, and ISO 9003 for being a model for quality assurance in only final inspection and testing. The first version of QMS standard or ISO 9000:1994 emphasized on quality assurance via preventive actions added. ISO 9001:2000 was integrated ISO 9001, 9002 and 9003 into one standard or ISO 9001 and making new standard, its main aim was to shift from “quality assurance” to “quality management” (UNIDO, 2012). Accordingly, it made a radical change in thinking based on process approach, structure (8 clauses), and customer satisfaction. The third version was published in Nov. 2008 with minimal changes made from the 2000 version but greater emphasis on customer focus and satisfaction (ISO, 2010). The main purpose of ISO 9001:2008 is to clarify existing requirements and to improve consistency of approach with other management standards like EMSs. Recently, ISO 9001:2015 (5^{th} ed.) was published in Sep. 2015. The latest edition is generated a radical change in thinking based on the identification of risk and risk control, structure with 10 clauses. Furthermore, this version can be integrated much better with other management standards (ISO, 2015d).

The ISO 9000 family for QMS is included (ISO, 2010):

- ISO 9000 – Quality management systems — Fundamentals and vocabulary;
- ISO 9001 – Quality management systems — Requirements;
- ISO 9004 – Managing for the sustained success of an organization — A quality management approach, and;
- ISO 19011 – Guidance for internal and external audits of quality management systems.

2.2.1 ISO 9001 -Quality management principles

Quality management principles are a set of fundamental beliefs, norms, rules and values that are accepted as true and can be used as a basis for quality management (ISO, 2015c). It is a framework to guide their organizations towards improved performance. ISO 9001:2008 has eight quality management principles. Recently, new version of quality management principles was published as ISO 9001:2015 that has seven principles only such as (ISO, 2015c):

1. Customer focus
2. Leadership
3. Engagement of people
4. Process approach
5. Improvement
6. Evidence-based decision making
7. Relationship management.

When it comes to project management ISO 9001 does not specify what the objectives relating to quality or customer satisfaction. Furthermore, it let organizations to define these objectives themselves and continues assessment help to improve their processes. (ISO, 2015). ISO 9001:2008 and 2015 both are based on process approach which help organizations to improve effectiveness and efficiency in achieving its objectives and customer satisfaction. All organizations use processes to achieve their objectives, ISO defined process are interrelated activities that use inputs to deliver an intended output. (ISO, 2015d). This process approach work as interface between functional hierarchies of the organization. (ISO, 2008). Furthermore, adopting ISO 9001 standard promote

developing, implementing and improving the effectiveness of quality management system, towards customer satisfaction.

Eight quality management principles have based on ISO 9001:2008 Quality management system series. Organizations can use these eight quality management principles as a frame work for improve organization performance. (ISO, 2005, V-VI)

Customer focus

"Organizations depend on customer and hence organizations need to understand future and current customer needs, so organizations need to meet customer needs and need to exceed customer expectations"

Leadership

"Leaders establish unity of direction and purpose for the organization. Leaders need to create and sustain the internal environment in which people can fully involve to achieve established objectives".

Involvement of people

People work in an organization in all levels consider as the essence of an organization, organization need to take their full involvement for benefit of the Organization,

Process approach

"Managing activities and related resources as process help to organizations achieve desired the result more efficiently"

System approach to management

"For an effective and efficient achievement of Organization objectives, Organization need Identify, understand and manage interrelated processes as a system."

Continual improvement

"The permanent goal of the organization need to be continual improvement of the organization's overall performance"

Factual approach to decision making

"Organizations need to take effective decisions for achieve its objectives for this effective decisions organizations need to base analysis of data and information"

Mutually beneficial supplier relationships

"An Organizations and its supplier have an interdependent relationship, a mutually beneficial relationship increases the capability of both to create value."

There are many studies about ISO certification's benefits to companies and its effects on performance but there is no consensus among results of studies. While some study conclude ISO Certification give benefits and increase organization performance, some conclude that ISO Certification not giving benefits and not increase organization performance.

2.2.2 Process approach

Understanding and managing interrelated processes as a system contributes to the organization's effectiveness and efficiency in achieving its intended results. This approach enables the organization to control the interrelationships and interdependencies among the processes of the system, so that the overall performance of the organization can be enhanced.

The process approach involves the systematic definition and management of processes, and their interactions, so as to achieve the intended results in accordance with the quality policy and strategic direction of the organization. Management of the processes and the system as a whole can be achieved using the PDCA cycle with an overall focus on risk-based thinking aimed at taking advantage of opportunities and preventing undesirable results.

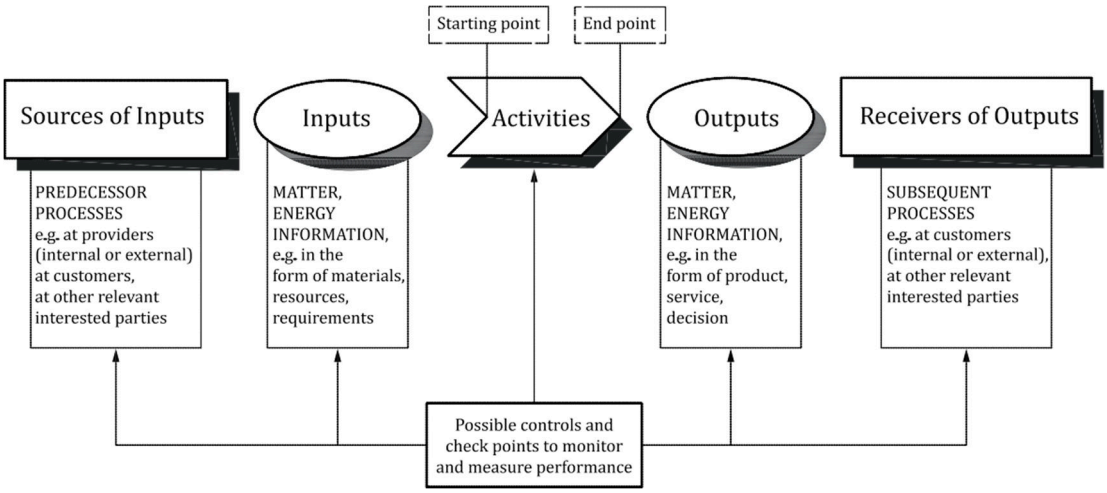


Figure 5: Schematic representation of the elements of a single process

Figure 1 gives a schematic representation of any process and shows the interaction of its elements. The monitoring and measuring check points, which are necessary for control, are specific to each process and will vary depending on the related risks.

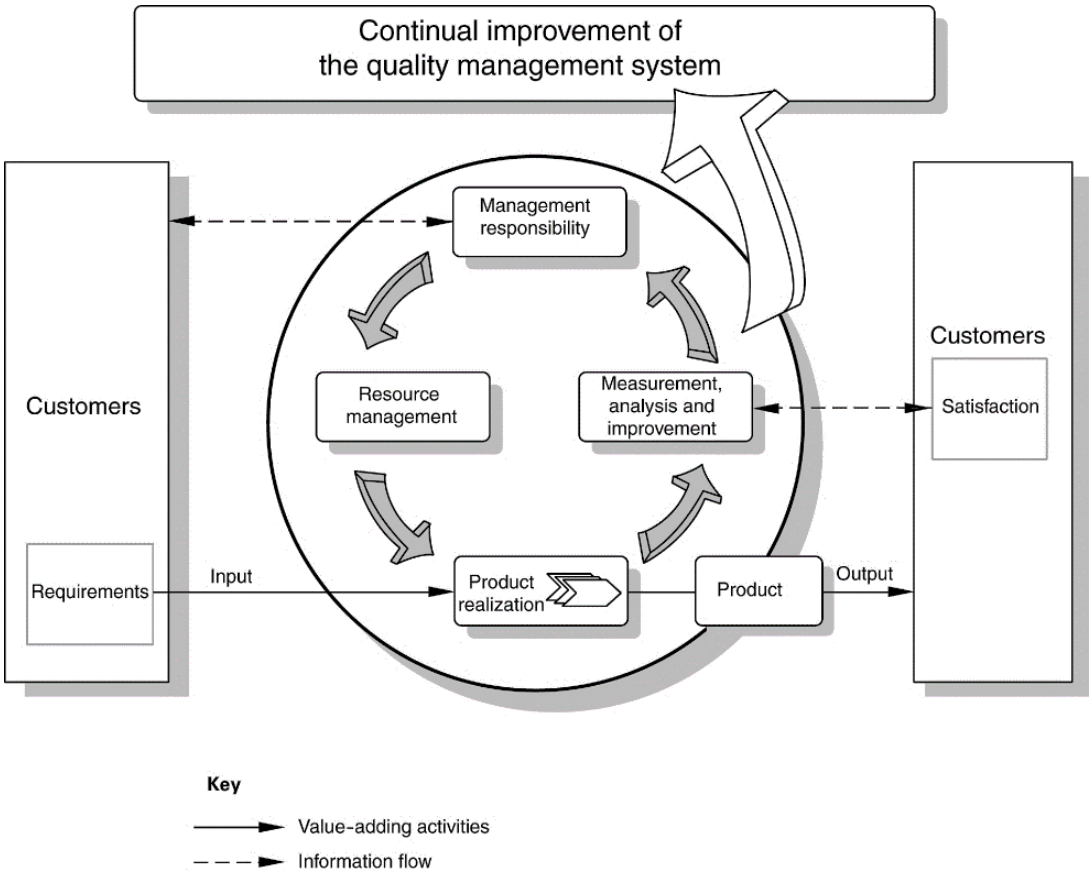
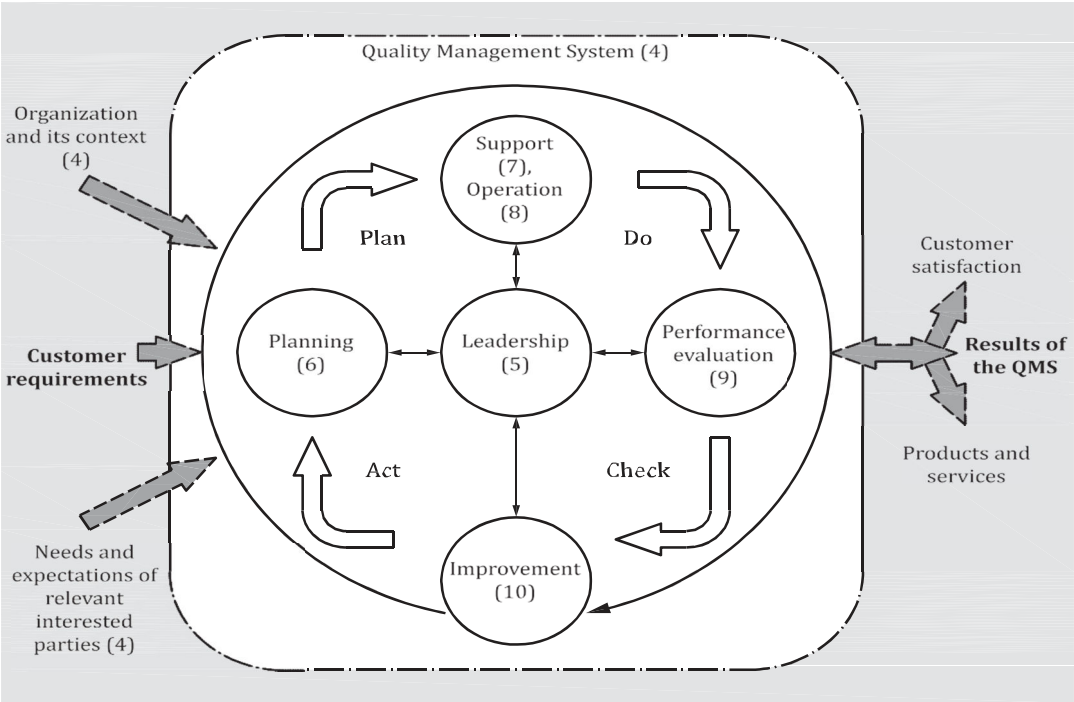


Figure 6: Model of a process-based quality management system
Source ISO 9001:2008 Standard

The Plan-Do-Check-Act (PDCA) approach is useful tool to define, implement, control corrective actions and improvements, The PDCA cycle is incorporates with ISO 9001:2008 which supports organizations to eliminate the problems by identification of root causes. (ISO/TC 176/SC 2/N 544R3).



(NOTE: Numbers in brackets refer to the clauses in this International Standard)

Figure 7: Representation of the structure of the PDCA cycle

According to the ISO 9001:2015 Quality management system has defined ten requirements which help to measure project success. (ISO 9001:2015)

1. Scope - aims to enhance customer satisfaction through continual improvement of the quality management system and conformity to customer and statutory and regulatory requirements.
2. Normative references
3. Terms and Definitions
4. Context of the Organization
5. Leadership
6. Planning
7. Support

8. Operation
9. Performance Evaluation
10. Improvement.

Kafetzopoulos, Pantouvakis and Fotopoulos (2013), conducted a research to find the degree of achievement of the Quality Management system's objectives, namely prevention of nonconformities, continuous improvement and customer satisfaction in service companies.

Below hypotheses used for the study

RH1. ISO 9001 effectiveness may well be described for the service companies by its objectives (prevention of nonconformities, continuous improvement and customer satisfaction focus) in a way similar to this of manufacturing companies.

RH2. ISO 9001 effectiveness as described by its objectives predicts and defines service company performance (related to product/service quality, operational and financial performance) in a cause and effect relationship. The research was conducted on ISO 9001 certified Greek service companies which the above research hypotheses are tested. 600 quality managers belonging to Greek service companies randomly selected from a pool of 1,000 ISO 9001:2008 certified service organizations listed at ICAP's (a Greek business information firm) database.

The research revealed that the ISO 9001 QMS has direct and significant influence for product/service quality and operational performance of the service companies. Further revealed that the financial performance is directly influenced only by operational performance, while the impact of ISO 9001 effectiveness is indirectly related with operational performance.

Another similar study was conducted by Psomas and Kafetzopoulos, (2014) based on 140 Greek manufacturing companies, in this study compared ISO 9001 certified and non-certified manufacturing companies with regard to performance measures, Non-parametric test method used to identify differences between the ISO 9001 certified and non-certified manufacturing companies

According to the study ISO 9001 certified manufacturing companies significantly exceed the non-certified with regard to its product quality, market and financial performance, customer satisfaction, operational performance.

Mei Feng, Mile´ Terziovski and Danny Samson conducted a similar survey in Australia and New Zealand-based manufacturing and service companies on the Relationship of ISO 9001:2000 quality system certification with operational and business performance. As per findings of their Mei Feng, Mile´ Terziovski and Danny Samson study, ISO 9000 Quality Management system certification has a positive and significant effect on operational performance but positive weak relationship with business performance.
Base on outcome of the study they have concluded that ISO 9000 certification by itself doesn't lead to improvement in performance of business.

A similar study was conducted by Michael Shadrack Mangula (2013) this study carried out in the Tanzania about ISO 9001 Quality Management System Certification effect on performance of Manufacturing Industries in Morogoro.
The Study found that companies certified for ISO 9001 Quality Management system show an enhancement in the product quality as well as production quantity. The Study revealed that ISO 9001 certification helped to increase the demand because of reduced the cost of production due to increase the efficiency.
Further study found that ISO 9001 certification help for organization become active and committed. Because of this situation customer become loyal and increase the quantity of products. His final conclusion was ISO 9001 implementation will have competitive advantages over the competitors.

A simile research to above research performed by Dr. Bichanga Walter Okibo (2013) under the topic of Effectiveness of ISO 9001:2008 Certification on Service Delivery of Public Universities in Kenya.
According to the above research they found that certified public universities' have a showed a positive relationship between flexibility to the changing market as a result of ISO certification. ISO certification has helped in continuously reviewing organizational structure, enhanced industrial based learning, enhanced general institutional publicity (public Awareness) and helps student placement after a course (post training). Further Study revealed that there is a positive relationship between ISO certification and teaching facilities improvements.

Casadesus et al.,(2005) conducted a research to find out benefits of implementing ISO 9001 by Spanish industries to this study they have found although ISO 9001 had many positive points, these points must be used in right context to maximize the benefits gained from the standard. According the outcome of the study: More than 90% of industries certified for ISO 9001 believe that ISO 9001 Quality Management System had benefited them and it is a good system improve the product and service quality

Luca Cagnazzo, Paolo Taticchi, and Francesco Fuiano have done a literature review on Impacts of ISO 9000 on business performances.
According the study several studies have revealed that ISO 9000 has benefits and positive influence for organization performance. This study has tried to give a classification of ISO impact for organization. Accordingly study has classified the impact for Organization as Internal impact and External impact. In this study they have consider not only finance performance but also non-financial indicators such as for instance the impact on the customers and suppliers, stakeholders , or the impact on service and product

Dr. David Muturi, Jacqueline Ochieng and Samuel Njihia perfomed a research on Impact of ISO 9001 Implementation on Organizational Performance in Kenya (2015)
Certain attributes were focused for the study and up to which extend ISO 9001 has influenced for those attributes of organizational performance was revealed the study. According to the survey ISO 9001 there is an impact for profit and turnover change, but the research further revealed that the profit and turnover differences are not significant. The study revealed a significant deference on return on assets. So study concluded that the ISO 9001 there is positive impact on company performance due to positive influence on the organizations' return on assets.

Dimitrios P. Kafetzopoulos Evangelos L. Psomas Katerina D. Gotzamani did a research under topic of "The impact of quality management systems on the performance of manufacturing firms"
This study give a theoretical basis for quality management and give a description about the controversial subject the influence of ISO 9001 implementation to a firm's performance

This study provides the definition of ISO 9001 effectiveness, the objectives of the standard, identifying three interconnecting dimensions. According to the survey results there is no direct impact for business performance, including marketing and financial measures on manufacturing firms.

Further study revealed that effectiveness of standard's directly effect to quality of product and performance, while indirectly contribute for performance of business through the moderator of operational performance. Also, the research shows that operational performance need to be consider when explain the impact to product quality. The study have observed that achievement of ISO effectiveness not in the same level it's differ organization to organization. An effective implementation of ISO 9001 gives the organization the opportunity for establish valuable and unique quality practices that will support it an advantage over its competitors. An effective ISO 9001 implantation differentiates an organization from competitors and lead to improved operational performance and product quality.

Therefore, Organizations need to focus on increase the level of ISO 9001 effectiveness for gain competitive advantages. In addition, the study pointed out that its need to clearly define the concept effectiveness of ISO 9001 standard. Many of the previous studies about the ISO 9001, concern generally implemented quality practices or assess the complexity of implementation of quality management systems by determining the level to which the standard's requirements are compiled or the degree to which an individual Origination's goals are achieved.

Furthermore, the previous theories that have been presented do not reflect for significant proportions of difference in the effectiveness of the standard. This study is the first study that accurately illustrate ISO 9001 effectiveness in link with its goals.

Sik Sumaedi, Medi Yarmen researched (2014) on The Effectiveness of ISO 9001 Implementation in Food Manufacturing Companies and Concluded that

Food Manufacturing Companies have widely adopted for ISO 9000 Quality Management System for improve the quality of products. But, it is a problem still how effective the ISO 9001 implementation in food manufacturing industry. This situation lead because of there is no widely accepted tool for measure how effective the implementation of ISO 9001 Quality Management System. Due lack of instruments to

measure the effectiveness of ISO 9001 implementation food manufacturing organization his study has tried to address the above gap.

Based on the study they performed, the paper suggested measurement tool of the effectiveness of ISO 9001 implementation in food manufacturing companies as shown in below table.

Table 3: Propose Measurements Instruments of ISO 9001 Implementation Effectiveness in Food Sector (Sik Sumaedi, Medi Yarmen researched: 2014)

Table 2. The Proposed Measurement Instrument of ISO 9001 Implementation Effectiveness in Food Sector

Dimension	Indicator	Supporting Literature
Customer Focus	3: The consistent & effective system of customer needs identification and review, The consistent & effective system of customer satisfaction measurement and improvement, The consistent & effective system of customer complaint handling	[5],[7],[8], [10], [13], [16], [17],
Leadership	4: Top management involvement, The Clear and deployed quality policy, The consistent & effective system of quality objective development and review, The management commitment for providing resources	[18], [19], [23]
Involvement of people	5: The clear and accepted job description, the competence of personnel, the consistent & effective system of training, the consistent & effective system of recruitment, employee satisfaction	
Process approach	3: The clear and effective the method for executing process; The consistent and effective process measurement system; The consistent and effective process control system	
System approach to management	2: The clear and effective business process; The consistent and effective internal communication system	
Factual approach to decision making	2: The consistent and effective data based decision making; The consistent and effective data collection	
Mutual beneficial supplier relationship	3: Supplier performance, Supplier satisfaction, The consistent and effective vendor selection and evaluation system	[5],[7],[8], [10], [13],
Continual Improvement	4: The consistent and effective audit internal system, The consistent and effective corrective and preventive system, The consistent and effective management review system, Rate of improvement	[16], [17], [18], [19], [23]
Product Performance	1: Product quality level	
Process Performance	3: Product defect per process, Process cost, Process Cycle time	
System & customer based performance	2: Customer satisfaction, Regulatory compliance	
Financial performance	1: Quality cost	

12 dimensions and 33indicators are included in the proposed measurement instrument. Further this include 8 leading dimensions, Those are involvement of people, customer focus, system approach to management, process approach, factual approach to decision making, continual improvement, and mutually beneficial supplier relationship, and 4 lagging dimensions, namely process performance, product performance, financial performance, and system and customer based performance.

Dejene Tulu has done a similar study about (September 2011) Impact of ISO 9001 Certification on Companies‟ Performance- The Case of Ethiopian Brewery Companies. In this study Dejene Tulu has been taken some variables to measure performance of organization with the help of ISO certification. Accordingly, in five Brewery Companies in Ethiopia business data have collected from the Central Statistical Agency of Ethiopia. Data were analysed by using descriptive statistic and tested the significance. ‟ Profit" has been taken as the dependent variable, the impacts of ISO certification along with average, cost average revenue and sales quantity is tested by using OLS with panel data. The result showed that average revenue and ISO certification have a significant positive effect on performance of Brewery companies. According to the study findings, ISO 9001 certification has a strong or a significant impact for company performance. This study has found that ISO 9001 certification effect to various areas in organization. Profit of the Organizations is considered for study purpose take as indicator of performance to a company in relation to ISO 9001 certification.

With this performance measure annual average revenues, annual average costs of the companies, annual sales volume and ISO certification is consider in the analysis procedures. The study has revealed that companies have increased the profit after the ISO 9001 certification when compare the profit before the ISO 9001 certification. Companies need to fulfil some pre requisite before ISO 9001 certification, implementation of pre requisite help to companies for increase the profit. ISO 9001 Helped to implement effective audits and it's helped to implement an improved production process, improved production process reduces cost and generate more revenues. Company annual average revenue also has been taken as a performance indicator. Annual average revenue variable also found to be significant to impact for the performance of the companies due to ISO 9001 certification. ISO9001 Certification Generate a high turnover due to most of customers demanding for their suppliers to get the ISO 9001 certification for guarantee their products quality consistency. Company having a ISO certification help to increase sales revenues in this way ISO certification help to companies for better revenues which can contribute for their profit performance. Moreover, ISO certification help to organization for expand for international business due to international business company can earn more turnover and its help to high profit. Finally according to result of study concluded that ISO 9001 certification have a positive influence for performance in brewery companies.

Abbas Al-Refaie, Ola Ghnaimat and Ming-Hsien Li did a study to test the Effects of ISO 9001 Certification on Performance of Jordanian Firms. They performance the study using structural equation modelling and respectively, t-test. Four areas were considered for the study of Effects of ISO 9001 Certification on organization Performance. Effect on Quality outcomes, business performance, customer satisfaction and innovation were tested through the research. ISO 9001 certified one hundred and thirty organizations were selected for study the Effects of ISO 9001 Certification on Performance. According to the results of study they found that ISO 9001 certification has a significant effect on business performance, quality outcomes and customer satisfaction. However, according to research finding ISO 9001 implementation there is no significant impact on innovation.

Dr. Omer Abdel Aziz El Tigani conducted a research on The Impact of the Implementation of the ISO 9000 Quality Management System upon the Perception of the Performance of the Organization's Worker (2011).

Dr. Omer Abdel Aziz El Tigani used a mixed method to this study, both secondary and primary sources used to find data for the study. Literature review was conducted as first phase and as the secondary phase he conducted a qualitative survey. 150 (n) employees operating in about 20 organizations working in the State of Qatar took as the sample. Through formal Questionnaire assessed the impact of the implementation of the ISO 9000 Quality Management System on the organizations' workers.

According to the research participant's perception in the study was application of the ISO 9000 Quality Management System does not improve and has no impact the performance of the organizations' workers. Further this research reviled some areas for the International Organization for Standardization (ISO) give the attention for improve the ISO 9001 Quality Management System.

P. M. C. Thilakarathne and S. K. C. Chithrangani performed a Study on Analysis of Managerial Attitudes towards ISO 9001: 2008 Quality Management System Introduction and Implementation Process in Sri Lanka (2014).
According to their results, 44 percent of the responded organizations were certified for ISO 9001: 2008 Quality management systems. This represents a satisfactory rate of

certification for quality management. 33 percent of the surveyed organizations had an interest to be certified under ISO 9001: 2008 system certifications. 07 percent of responded organizations which were not certified for ISO 9001: 2008 quality management system had already commenced the system implementation, including preparation of documents pertaining to ISO 9001: 2008 quality management system implementations. 16 percent of organizations surveyed under this research were not interested in implementing ISO 9001: 2008 quality management system certifications. According to P. M. C. Thilakarathne, and S. K. C. Chithrangani (2014), the most important perceived benefits from implementing ISO 9001 in Sri Lankan certified companies could be summarized as follows,

1. Customer satisfaction
2. Increase quality awareness
3. Improves employee productivity
4. Helps to develop quality management
5. Improves the efficiency of the quality system
6. Improves the product / service quality
7. Product development tool

Durai Anand Kumar and V. Balakrishnan (2011) performed a study on ISO 9001 quality management system (QMS) certifications – reasons behind the failure of ISO certified organizations.

The study revealed that even though more than one million Organization around the world certified for ISO 9001 there are few common problems faced by most of Organizations, Those problems include their business performance. These issues are broadly categorized as below

- Issues related to Leadership (Lack of Motivation, Inadequate Commitment by Top Management, Organizational learning, Recognition, Strategic Planning and long term focus)
- Issues Related to Strategy (Vision, Mission, Values, Strategy Mapping, Strategic Planning, Cascading down the line, Initiatives and KPIs)

- Issues related to Quality System (Poor Plan-Do-Check-Act cycle, internal audit not in depth, generic system, excessive paperwork and non-value adding meetings/trainings)
- Society oriented gaps (Corporate Social Responsibility, Environmental Management and Sustainability)

When an organization carefully removes gaps mention above, it can be assured of the entire business model to be effective with value added methods, processes, systems and efficient resources contributing for towards business excellence and continual improvements.

2.3 Critical elements of a construction projects

According to Kerzner (2010) the project can be considered to be any series of tasks and actions to achieve a set of goals and defined objectives by utilizing available resources throughout several functional lines. Most important aspect of project management is analyzing the information related to the project objectives to tally with organization and business objectives to survive in the market and competing with other competitive organizations. So project success depends on the success of the organization. (PMI, 2008). As mentioned in the Table 3 different authors have mentioned the project success in different ways, but the project success is still remained ambiguously defined. Because of that defining and identification of the project success is complicated.

Table 4: Definition of success factors of projects by different authors

Author	**Success factors of projects**
Kerzner (2010)	Time, cost, performance /technology /resource and within good customer relationship.
PMI(2008)	Time, cost, quality, scope, resources, risk, identified requirements, and satisfaction of stakeholders.
Rasmy (2008)	Time, cost, customer's requirements
Rezaian (2011)	Time, cost, quality, risk
Neyestani (2016)	Time, cost, quality, and customer's satisfaction
Varajao et al.	Time, cost, scope

CHAPTER 03 - RESEARCH METHODOLOGY

3.1 Research Design

This research was designed to evaluate the effectiveness of QMS on the state sector construction organization. Thus, literature review was first carried out to understand the topic, and the concepts of the study in order to develop a questionnaire for obtaining data from the managerial staff of construction projects. The questions were designed on the basis of literature review and preliminary studies and questionnaires were randomly distributed among managerial staff of ISO9001:2015 implemented state sector organizations.

Steps in Research Design

The steps in the research methodology is to,

- Identify the factors which affect for success of a construction projects.
- Operationalize the effectiveness of the QMS by identifying the factors according to the requirements of ISO 9001(Identify variables and indicators)
- Develop the questionnaire based on the operationalized variables and indicators.
- Identify the state sector construction organizations as the source of information.
- Distribute the questionnaire among the Project Managers, Engineers and Quantity surveyors to gather the information necessary for the assessment.

3.1.1 Areas under the assessment

1. **Scope**- This scope is a vital part of the quality manual, as it defines how far the QMS extends within the company's operations, and details any exclusion from the ISO 9001 requirements and the justification for these. It is through the scope that you define what your Quality Management System covers within your organization
2. **Normative references** - means that the information (concepts, principles and definitions) should be understood and applied as defined or explained in ISO 9000. It is quite possible that such information may have different meaning or interpretation in some industries, regulatory or business context

3. **Terms and definitions –** Applicable terms and definitions are given as in ISO 9001:2015
4. **Context of the organization**- Understanding the organization and its context, Context of the organization is a new requirement in ISO 9001, stating an organization must consider both the internal and external issues that can impact its strategic objectives and the planning of the QMS. It is also a means to detect risks and opportunities regarding the business context
5. **Leadership** - Employees at every level are instrumental to the success of the quality management system, even if commitment to certification starts at the top.
6. **Planning** - Adding risk-based thinking and management to planning. Establishing quality objectives and how they will be achieved. Planning actions when changes to the QMS are made
7. **Support** - resources, targeted internal and external communications, as well as documented information that replaces previously used terms such as documents, documentation, and records. The organization needs to supply competent resource to deliver its goods and services.
8. **Operation** - Key Requirements: Plan, implement and control processes need to meet requirements for products and services.
9. **Performance evaluation** - Requires the analysis and evaluation be used to evaluate the "degree" of customer satisfaction. Clause 8.4 in ISO 9001:2008 refers to analyzing data to provide information on conformity to product requirements.
10. **Improvement** - the requirement for continual improvement (CI) is defined in clause 8.5.1 "Continual Improvement". Continual Improvement can be initiated through the use of quality policy, quality objective, audit results, analysis of data, corrective and preventive actions and management review.

Variables, Indicators and measurement

Variable	Indicator	Measure
Leadership & Planning (Clause No 5 & 6 of ISO 9001:2015)	1. Top management has shown their significant contribution to the effective implementation of QMS	Number
	2. Top management is aware of the risk and opportunities of the business environment	Number
	3. Established quality objectives help to meet customer satisfaction & continual improvement of processes	Number
	4. Employees of the organization are aware about how they contribute to the achievement of the quality objectives	Number
	5. Employees of the organization are clear on their duties, responsibilities and authority in meeting customer and regulatory requirements	Number

Variable	Indicator	Measure
Performance Evaluation & improvement (Clause No 9 &10 of ISO 9001:2015)	1. Organization is monitoring and evaluate the performance and the effectiveness of the QMS	Number
	2. Base Data analysis use as a tool for management decisions	Number
	3. Internal audit helped to identify system deviation that can effect to the quality of construction	Number
	4. Management review meetings are conducting according to defined periods & take effective decisions and actions regarding the QMS	Number

	5. Corrective action procedure use as a tool to prevent recurrence of non-compliances and the organization continually improve the QMS	Number

Variable	**Indicator**	**Measure**
Support (Clause No 7 of ISO 9001:2015)	1. Required competencies for each positions have defined & strict to those requirement when recruiting new employees	Number
	2. Base on training need identification organization provide sufficient training opportunities for all employees	Number
	3. Organization is maintaining and continually updating required knowledge, information in relevant with their operation, processes, services	Number
	4. Organization provides necessary infrastructure facilities that are helpful to achieving customer and regulatory requirements	Number
	5. Organization provides a Work environment that are helpful to achieving customer and regulatory requirements	Number

Variable	Indicator	Measure
Operation (Clause No 8 of ISO 9001:2015)	Available documentation system help to adequately identify client's requirements & changes in client's requirements	Number
	Organization is much keen on the quality of products, works and services by the external suppliers	Number
	Available Measuring & monitoring equipment help to ensure the quality of constructions	Number
	In process & Final quality Inspection of the construction help to ensure that met customer requirements	Number
	Purchasing procedure & Incoming inspection help to ensure the required quality of raw material	Number
	Non-conforming products or out puts are clearly identified and controlled	Number

Variable	Indicator	Measure
Effectiveness of QMS on Scope/Quality:	1. Scope of the project is identified adequately before implementation	Number
	2. Amount of reworks to be done declined	Number
	3. Non-conformities detected declined & Quality of works improved	Number
	4. Improved capability to project scope statement, requirements documentation, and detailed project plan	Number
	5. QMS is effective in achieving Project & Quality Objectives	Number
	6. Accuracy and presentation of the work by improving quality assurance and control	Number

	7. Helped to improve awareness of project objectives	Number
	8. Identification, Correction and taking corrective measures were improved	Number

Variable	Indicator	Measure
Effectiveness of QMS on Project's Cost:	1. To effectively resolve problems of construction on project with minimum changes to the project cost	Number
	2. Business outputs are tracked and measured, which means areas of waste and reworks can be identified and reduced	Number
	3. Increased ROI and profit could increase by optimizing the cost	Number
	4. Optimizing performance can reduce expenses by efficient process management and resources	Number
	5. Lower construction costs because of fewer nonconforming works, less rework, lowered rejection rates, streamlined processes and fewer mistakes	Number
	6. A well-managed supply chain can reduce expenses	Number

Variable	Indicator	Measure
Effectiveness of QMS on Client's Satisfaction:	1. Decreased in client's complaints	Number
	2. Improved customers relationship, communication, and reporting	Number
	3. Enhanced reputation of the organization and Brand image among the clients	Number
	4. Increasing business benefits (ROI, NPV etc.)	Number
	5. Improved customer loyalty	Number
	6. Improved common understanding of goals and values among interested parties	Number
	7. Processes are in place to track and resolve issues quickly and effectively	Number

Number	Variable	Measure
1	Leadership and Planning	Number
2	Support	Number
3	Operation	Number
4	Performance Evaluation and improvement	Number
5	Effectiveness of QMS on Scope/Quality	Number
6	Effectiveness of QMS on Time	Number
7	Effectiveness of QMS on Cost	Number
8	Effectiveness of QMS on Client's satisfaction	Number

3.1.2 Research Questionnaire

Research questionnaire was developed to assess the identified variables and controls. As the faster and cheaper instrument questionnaire was used as primary tool for collecting data. In this research, the survey questionnaire was consist of two main sections. Section I is related to the general information of the respondents. Section II was consists two main parts, where first part focuses on identifying the barriers of effective implementation of QMS and second part was focuses on the evaluation of effectiveness of QMS implementation on triple constraints of construction projects. The questions asked were closed-ended with a five point Likert rating scale. Moreover, the questionnaires were personally distributed and retrieved by the researcher to target respondents which helped to get good respond rate. Furthermore, the confidentiality and anonymity of participants were protected by not including their name on the questionnaire.

Following guideline was considered when allocating the marks.

Category	**Marks**
Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

A sample questionnaire is at annexure 1

3.1.3 Selection of construction Companies

For this study select the state sector construction industry, state sector Constructions industry play an important role for development of Sri Lanka. The contribution of Construction industry for Gross Domestic Production (GDP) has significant improvement during last few years. Further construction Industry provide significantly high number of job opportunities for Sri Lankan work force.

The Sri Lankan state sector organizations are CECB (Central Engineering Consultancy Bureau), SEC (State Engineering Corporation) and SD&CC (State Development and

Construction Corporation) which are ISO 9001 certified companies. The majority of the state sector construction companies face many challenges and problems, such as delay and cost overrun in complementing their projects in Sri Lanka.

3.2 Data Collection

Main source of data collection was questionnaire and random sampling method was used in choosing the respondents. Subsequently, a questionnaire was designed based on previous studies and then distributed randomly among the 80 managerial level employees to collect data. Finally, data analysis was conducted using descriptive statistics to find the result and conclusion. Participants in the study were managerial level employees (Project Managers, Engineers and Quantity Surveyors) in different levels, areas, and specialists within the construction organizations. Basically, total of 44 usable questionnaires were collected, and used in the statistical analysis. Further, collecting data some of the top level participants had to meet and interview to get the data because of poor respond rate.

Moreover, for the further details in the research, journals, books and articles used as secondary sources.

3.3 Analysis of data

In this study, data analysis was based on descriptive statistics and MS Excel was used to analyze data. The designed questionnaire let the respondents to provide their opinion based on their experiences. Likert-scales are proper and widely used for opinion management. Descriptive statistics provide simple summaries about the sample and about the observations that have been made. In the business world, descriptive statistics provides a useful summary of many types of data.

Relative Importance Index Technique: It has used to determine the relative importance of the various causes and effects of delays.

The same method is going to adopted in this study within various groups (engineers, quantity surveyors).

The five-point scale ranged from 1 (very little degree affect) to 5 (very high degree affect) is adopted and transformed to relative importance indices (RII) for each factor as follows:

$$RII = \Sigma W / (A*N)$$

CHAPTER 4 - DATA PRESENTATION AND ANALYSIS

4.1 Introduction

The purpose of this research was to set directives evaluate the Impact of ISO 9001 Based Quality Management System (QMS) on Project Performance of State Sector Construction Organizations in Sri Lanka. The research questions (RQ) framed in this study are as follows

28 responses out of 40 questionnaires were received from the CECB which has the highest contribution to state sector construction industry. 9 responses out of 20 and 7 responses out of 20 questionnaires were respectively received from the SD&CC, SEC which is other two main state sector construction industry.

4.2 Background of Respondents

The finding of this study based on 44 in top, medium and lower level of management working in state sector organizations.

Following details consist of respondent's working experience, exposure to the QMS activities and their level of contribution and involvement for the implementation and continual improvement of organization's QMS

Table 5: Ratings of Respondent's Working Experience

Respondent's Working Experience	Frequency	Percentage	Rank
Below 5 Years	4	9%	5
Between 6 and 10 Years	6	14%	3
Between 11 and 15 Years	11	25%	2
Between 16 and 20 Years	14	32%	1
Between 21 and 25 Years	6	14%	3
Above 25 Years	3	7%	6

According to the analysis more than 75% selected employees were having more than 10 years of work experience and more than 50% having more than 15 years of work experience.

Table 6: Ratings of respondent's exposure to the QMS activities within the working experience

Respondent's Exposure to the QMS within Working Experience	**Frequency**	**Percentage**	**Rank**
Below 2 year	5	11%	4
Between 2 and 5 years	10	23%	2
Between 5 and 8 years	16	36%	1
Between 8and 10 years	9	20%	3
10 and above	4	9%	5

Around 65% of the selected employees had more than 5years of exposure to the QMS related activities within the working environment.

Table 7: Ratings of respondent's level of contribution and involvement for the implementation and continual improvement of organization's QMS

Respondent's Level of Contribution	**Frequency**	**Percentage**	**Rank**
Low	12	27%	2
Moderate	25	57%	1
High	7	16%	3

Approximately, 75% of the employees having direct involvement for the implementation and management of organization's QMS.

Section two of the Questionnaire is focused on calculating the results according to Relative Importance Index.

Relative Importance Index Technique: It has used to determine the relative importance of the various causes and effects of delays.

01. The same method is going to adopted in this study within various groups (engineers, quantity surveyors).

The five-point scale ranged from 1 (very little degree affect) to 5 (very high degree affect) is adopted and transformed to relative importance indices (RII) for each factor as follows:

$$RII = \Sigma W / (A*N)$$

4.3 Data Analysis of Part 1 of section two (Main Clauses of ISO 9001:2015)

Analysis of the Part one of the questionnaire help to identify the barriers of the effective implementation of QMS.

4.3.1 Analysis for Leadership and Planning (Clause No 5 and 6 of ISO 9001:2015)

When considering about Leadership and Planning which cover ISO 9001 clauses 5 and 6 help to understand management related barriers to effective implementation of QMS. As mentioned in the research problem one of the main barriers to effective implementation of QMS is “ISO consider as a marketing tool “, therefore it’s difficult to get the optimum advantages of the QMS. According to the data analysis it clearly show least Rank is to top management contribution to effective implementation of QMS and 30% agreeing and 0% strongly agreeing. Total of disagreeing 36%, and more than 50% shows that there is no enough management support to effectively implement QMS. When it consider about customer satisfaction more than 75 % have agreed that there is clear relationship between customer satisfaction and the QMS. More than 60% of the employees clear about their responsibilities and duties when it comes to customer satisfaction.

Table 8: Ratings of Leadership and Planning (Clause No 5 and 6 of ISO 9001:2015)

Leadership and Planning (Clause No 5 and 6 of ISO 9001:2015)	**Percentage (%)**					**IRI**	**Rank**
	1	**2**	**3**	**4**	**5**		
1. Top management has shown their significant contribution to the effective implementation of QMS	11	25	34	30	0	0.564	5
2. Top management is aware of the risk and opportunities of the business environment	2	14	34	50	0	0.664	3
3. Established quality objectives help to meet customer satisfaction and continual improvement of processes	2	1	25	55	7	0.705	1
4. Employees of the organization are aware about how they contribute to the achievement of the quality objectives	2	7	43	48	0	0.673	2
5. Employees of the organization are aware on their duties, responsibilities and authority in meeting customer and regulatory requirements	11	16	32	36	5	0.614	4

4.3.2 Analysis for Support (Clause No 7 of ISO 9001:2015)

Only 2% of the employees have said that required competencies for each positions have defined and strict to those requirement when recruiting new employees. Again other than 2% others are positively saying that organizations providing sufficient training opportunities for all employees. Around 50% is satisfactory about knowledge improvement and 35% disagree with it. Totally more than 60% agree that company providing better working environment with relevant infrastructure.

Table 9: Ratings of Support (Clause No 7 of ISO 9001:2015)

Support (Clause No 7 of ISO 9001:2015)	**Percentage (%)**					**RII**	**Rank**
	1	**2**	**3**	**4**	**5**		
1. Required competencies for each positions have defined and strict to those requirement when recruiting new employees	2	0	27	66	5	0.741	1
2. Base on training need identification organization provide sufficient training opportunities for all employees	2	0	43	55	0	0.700	2
3. Organization is maintaining and continually updating required knowledge, information in relevant with their operation, processes, services	5	30	25	39	2	0.609	5
4. Organization provides necessary infrastructure facilities that are helpful to achieving customer and regulatory requirements	2	41	5	41	11	0.636	4

5. Organization provides a Work environment that are helpful to achieving customer and regulatory requirements	2	9	43	39	7	0.677	3

4.3.3 Analysis for Operation (Clause No 8 of ISO 9001:2015)

In this table it shows that highest rank goes to organization is much keen on the quality of products, works and services by the external suppliers. Around 69% of the staff agree that organizations much worry about the quality of external supplies. Around 75% of the staff shows that available measuring and monitoring equipment help to ensure the quality of constructions. According to this data analysis shows that non-conforming products or out puts are clearly identified and controlled within the products. In operations other than the "process and Final quality Inspection of the construction help to ensure that met customer requirements" question all the other questions scored RII more than 0.7. This shows that QMS can help organizations to manage construction related operations effectively.

Table 10: Ratings of Operation (Clause No 8 of ISO 9001:2015)

Operation (Clause No 8 of ISO 9001:2015)	**Percentage (%)**					**RII**	**Rank**
	1	**2**	**3**	**4**	**5**		
1. Avai1able documentation system help to adequately identify client's requirements and changes in client's requirements	2	9	14	75	0	0.723	4
2. Organization is much keen on the quality of products, works and services by the external suppliers	2	11	18	39	30	0.764	1
3. Available Measuring and monitoring equipment help to ensure the quality of constructions	2	0	23	66	9	0.759	2

4. In process and Final quality Inspection of the construction help to ensure that met customer requirements	2	11	57	30	0	0.627	6
5. Purchasing procedure and Incoming inspection help to ensure the required quality of raw material	5	0	36	59	0	0.700	5
6. Non-conforming products or out puts are clearly identified and controlled	2	0	23	75	0	0.741	3

4.3.4 Analysis for Performance Evaluation and improvement (Cl. 9 & 10 of ISO 9001:2015)

Under the performance evaluation the highest ranked one is internal audit helped to identify system deviation that can effect to the quality of construction. For this only 5% disagreed and 69% agreed. The second ranked is corrective action procedure use as a tool to prevent recurrence of non-compliances and the organization continually improve the QMS, 68% agreed on this. Third ranked one is organization is monitoring and evaluate the performance and the effectiveness of the QMS. By looking at the overall performance,

Table 11: Ratings of Performance Evaluation and improvement (Clause No 9 and10 of ISO 9001:2015)

Performance Evaluation and improvement (Clause No 9 and10 of ISO 9001:2015)	**Percentage (%)**					**RII**	**Rank**
	1	**2**	**3**	**4**	**5**		
1. Organization is monitoring and evaluate the performance and the effectiveness of the QMS	5	2	36	52	5	0.700	3
2. Base Data analysis use as a tool for management decisions	2	11	32	55	0	0.677	4

3. Internal audit helped to identify system deviation that can effect to the quality of construction	5	0	27	64	5	0.727	1
4. Management review meetings are conducting according to defined periods and take effective decisions and actions regarding the QMS	14	16	30	23	18	0.632	5
5. Corrective action procedure use as a tool to prevent recurrence of non-compliances and the organization improve the QMS	2	16	14	59	9	0.714	2

4.4 Data Analysis of Part 2 of section two (Key Project performance Indicators)

4.4.1 Analysis for Effectiveness of QMS on Scope/Quality

Under this category, highly ranked on non-conformities detected declined and Quality of works improved, that means QMS help to identify non-conformities and help to improve quality of work.

Second ranked one is identification, Correction and taking corrective measures were improved. Only 2% were disagree with this. For a project success, awareness of project objectives is very crucial and around 70% agree on this. Majority of questions having more than 0.7 of RII. This indicate having QMS help to manage scope well which will lead to project success.

Table 12: Ratings of effectiveness of QMS on Scope/Quality

Effectiveness of QMS on Scope/Quality	**Percentage (%)**					**RII**	**Rank**
	1	**2**	**3**	**4**	**5**		
1. Scope of the project is identified adequately before implementation	5	0	36	55	5	0.709	4
2. Amount of reworks to be done declined	2	5	41	43	9	0.705	5

3. Non-conformities detected declined and Quality of works improved	0	5	18	75	2	0.750	1
4. Improved capability to project scope statement, requirements documentation, and detailed project plan	2	11	48	36	2	0.650	7
5. QMS is effective in achieving Project and Quality Objectives	5	16	27	52	0	0.655	6
6. Accuracy and presentation of the work by improving quality assurance and control	2	5	61	32	0	0.645	8
7. Helped to improve awareness of project objectives	0	5	27	66	2	0.732	3
8. Identification, Correction and taking corrective measures were improved	0	2	25	73	0	0.741	2

4.4.2 Analysis for Effectiveness of QMS on Time

89% agree on scheduling and programming were improved and more realistic schedules could be achieved, moreover proper scheduling help to achieve project success. The second highest scored one is Documented procedures are helpful to achieve time targets which means QMS can help to achieve time constraints. Third ranked one is Timely identification of issues and taking proactive measures were improved. There are twelve questions under the time management and all most all scored RII more than 0.5 and majority more than 0.7. Likewise QMS shows clear relationship with Time.

Table 13: Ratings of effectiveness of QMS on Time

Effectiveness of QMS on Time	**Percentage (%)**					**RII**	**Rank**
	1	**2**	**3**	**4**	**5**		
1. Efficiency in meeting time targets and milestones were improved	2	7	41	43	7	0.691	8

2. Delays in project completion was reduced satisfactorily	5	18	68	9	0	0.564	12
3. Timely identification of issues and taking proactive measures were improved	2	0	16	68	14	0.782	3
4. Factors affecting time delay could be easily identified and resolved	2	0	27	68	2	0.736	7
5. Affect to the timelines by scope changes were minimized	2	23	50	25	0	0.595	11
6. Scheduling and programming were improved and more realistic schedules could be achieved	5	0	7	66	23	0.805	1
7. Reduction of delay, that are related of failure and shortage, and delivery of the materials	2	16	32	50	0	0.659	10
8. Reduction of delay, as a result of lack of communication between parties involved	5	0	23	66	7	0.741	6
9. Reduction of delay, as a result of unnecessary and without reason of inspections and testing	2	0	52	41	5	0.691	8
10. Enhanced ability to anticipate project completion time, delay and its reasons	2	0	18	75	5	0.759	5
11. A well-managed supply chain that provides a stable flow of goods and services to prevent delay	5	0	34	32	30	0.764	4
12. Documented procedures are helpful to achieve time targets	2	0	7	80	11	0.795	2

4.4.3 Analysis for Effectiveness of QMS on Project's Cost

Under the project cost factor, highest ranked on Business outputs are tracked and measured, which means areas of waste and reworks can be identified and reduced which shows QMS can help to reduce wastage. Third ranked one is A well-managed supply chain can reduce expenses and like this organizations can reduces unnecessary wastage. The fourth ranked one is Optimizing performance can reduce expenses by efficient process management and resources which help to reduce hidden cost and can improve performance with proper resource management.

Table 14: Ratings of Effectiveness of QMS on Project's Cost

Effectiveness of QMS on Project's Cost	Percentage (%)					RII	Rank
	1	2	3	4	5		
1. To effectively resolve problems of construction on project with minimum changes to the project cost	0	0	32	52	16	0.768	5
2. Business outputs are tracked and measured, which means areas of waste and reworks can be identified and reduced	0	2	0	84	14	0.818	1
3. Increased ROI and profit could increase by optimizing the cost	0	0	43	52	5	0.723	6
4. Optimizing performance can reduce expenses by efficient process management and resources	0	5	9	77	9	0.782	4
5. Lower construction costs because of fewer nonconforming works, less rework, lowered rejection rates, streamlined processes and fewer mistakes	0	0	18	57	25	0.814	2
6. A well-managed supply chain can reduce expenses	0	0	20	55	25	0.809	3

4.4.4 Analysis for Effectiveness of QMS on Client's Satisfaction

Under the client satisfaction there are seven questions and all most all the questions are having RII more than 0.8. Highly ranked one is Enhanced reputation of the organization and Brand image among the clients. Second ranked one is improved customers relationship, communication, and reporting. Third ranked one is decreased in client's complaints. According to this analysis it clearly shows that QMS and customer satisfaction is having a good relationship. Moreover, it helps to reduce customer complaints and it leads to reduce rework and enhance the good reputation which leads to reduce the cost also.

Table 15: Ratings of Effectiveness of QMS on Client's Satisfaction

Effectiveness of QMS on Client's Satisfaction	**Percentage (%)**					**RII**	**Rank**
	1	**2**	**3**	**4**	**5**		
1. Decreased in client's complaints	2	0	9	55	34	0.836	3
2. Improved customers relationship, communication, and reporting	2	0	0	50	48	0.882	2
3. Enhanced reputation of the organization and Brand image among the clients	0	0	16	23	61	0.891	1
4. Increasing business benefits (ROI, NPV etc.)	2	0	36	55	7	0.727	7
5. Improved customer loyalty	2	0	11	64	23	0.809	5
6. Improved common understanding of goals and values among interested parties	5	0	27	39	30	0.777	6
7. Processes are in place to track and resolve issues quickly and effectively	2	0	11	57	30	0.823	4

4.5 Summary Data analysis for Overall ratings

4.5.1 Summary for each Category of main clauses of ISO 9001:2015

Table 16: Overall ratings for each Category of main clauses of ISO 9001:2015

Description of the Category	Average Relative Important Index	Rank
2(a).1 Leadership and Planning (Clause No 5 and 6 of ISO 9001:2015)	0.644	4
2(a).2 Support (Clause No 7 of ISO 9001:2015)	0.673	3
2(a).3 Operation (Clause No 8 of ISO 9001:2015)	0.719	1
2(a).4 Performance Evaluation and improvement (Clause No 9 and10 of ISO 9001:2015)	0.690	2

According to the above table the highest ranked operations, clearly shows that operations such as documentation and available measuring and monitoring help to achieve overall quality with customer satisfaction. Performance Evaluation and improvement, Support and Leadership planning also showing importance index around 0.6 shows that it is having medium importance for project success.

4.5.2 Summary for each Category of project performance indicators

Table 17: Overall ratings for each Category of project performance indicators

Description of the Category	Average Relative Important Index	Rank
2(b).1 Effectiveness of QMS on Scope/Quality	0.698	4
2(b).2 Effectiveness of QMS on Time	0.715	3
2(b).3 Effectiveness of QMS on Cost	0.786	2
2(b).4 Effectiveness of QMS on Client's Satisfaction	0.821	1

According to the above table Effectiveness of QMS on client's satisfaction is having the highest rank and it shows that how positively QMS can influence on Triple constraints. All most all the factors overall score of RII is around 0.7. Which means that effective implementation of QMS can highly influence on project success.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Summary

All state sector organizations CECB, SEC and SD&CC are certified for ISO 9001:2015 Quality Management System Certification. Other than the CIDA requirements these organization had various objectives for implement the ISO 9001:2015 Quality management System. Operational Excellence is the overall objective of implementation of ISO 9001:2015 standards.

The main objective of this research is to identify the effectiveness of ISO 9001:2015 on construction projects and identify the barriers of effective implementation of QMS. Therefore ISO 9001:2015 standard is the base for this study. ISO9001:2008 has 8 clauses and ISO 9001:2015 is having 10 clauses. Out of these clauses six clauses are directly related to the Operations of the Organization which are namely, Leadership, Planning, Support, Operation, Performance Evaluation and Improvements.
Based on the above variables questionnaire was developed. Data was collected from three state sector construction Organizations and gathered data was analyzed using statistical tool, to give conclusions and valuable recommendations.

5.2 Conclusions

In this study, literature review uncovered that the implementation of QMS can be an effective technique to achieve the objectives of a projects successfully through process approach, which is based on “PDCA” methodology towards the optimization of project performance, and problem solving. From literature review, it was revealed that project success is the most efficient key to assess projects in construction industry, and the customer’s satisfaction as business objectives, and triple constraints (cost, time, quality) are the most significant elements in success of construction projects according to scholars. Moreover, after thorough analysis of ISO 9001:2008 and ISO 9001:2015 helped to understand eight key factors which contribute to the project success.
Furthermore, the results of the study from the responses of 44 managerial staff, have been identified that QMS can be affected mostly on customer’s satisfaction. It may justified that the impact of QMS on customer’s satisfaction is more than other vital

criteria in construction projects, because process approach of QMS is considered and prioritized the customer's requirements and satisfaction, as its input and output in the organizations. Likewise, QMS can affect directly and indirectly on cost and time in the projects, while the lowest impact of QMS is on quality/scope. According to the project staff, implementing QMS help to overall quality of construction projects over customer satisfaction.

While, the implementation of all standard of QMS can even improve incrementally quality/scope, reduce the cost and time length of the construction projects, and promote customer's satisfaction. However, the study concluded that QMS is an appropriate quality management and marketing tools for developing and improving organization performance. In this context it is suggested to implement QMS standard in the projects to improve organization performance.

5.3 Recommendations

As per the Table 4.4 Data 25% respondents neutral about the question "Established quality objectives help to meet customer satisfaction and continual improvement of process". Hence it is recommend to Organizations for revisit the Objective setting process and set objectives as help to meet customer satisfaction and continual improvement of process. Further 43% of respondents neutral on "All employees are aware about how they contribute to the achievement of the quality objectives". Hence it is recommend to communicate to employees what their contribution for achieve quality objectives through training and awareness programs. Moreover, 43% neutral on training need identification and organization provide sufficient training opportunities for all employees.

30% of respondents are neutral on Management Review Meeting so it is recommend to Managements to Conduct Management Review Meeting more structural manner and take effective management decisions.

Furthermore, data 11% disagree and 43% neutral on work environment that are helpful to achieving customer and regulatory requirements, therefore organizations should consider about providing suitable work environment.

As per the Table Data 31% respondents neutral about the question "Internal audit helped to identify system deviation that can effect to the quality of construction". So it

is need to improve the quality of internal audit to identify deviations that can effect to the quality of contraction. For this it is need to provide more training opportunities for internal auditors and management team members actively participate for internal audit and it is recommend to consider internal audit findings as very important.

As per the Table 4.6 Data 13% Disagree and 57% Neutral on process and Final quality inspection of the construction help to ensure that met customer requirements therefore Organization Managements need to be seriously revisit the existing quality inspection process with the perspective of customer satisfaction.

5.4 Suggestions for further research

This study is based on implementation of main six clause in the ISO 9001: 2015 Standard and organization finance and operational performance in state sector construction companies, this study made a base for further Research areas like ISO 9001:2015 Implementation and Employee Performance, ISO 9001 Implementation and Customer Perception, and ISO 9001:2015 Implementation and Employee Motivation

This study was conducted base on state sector construction companies and research can be extended to the companies under CIDA C1, C2 and C3 categories there for research scope limited to construction industry and few CIDA categories, hence conduct a study as cover others industry's as well give a much more correct picture about ISO 9001:2015 Quality Management System and its effect for organizations performance.

Furthermore, the study suggests to identify the best ways for the sustainable development of construction projects from the perspective of implementation of a QMS.

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APPENDIX

Dear Sir / Madam,

I am a Post Graduate student at Department of Civil Engineering, Faculty of Engineering, University of Moratuwa. As a partial fulfillment to the M.Sc. degree programme, I need to carry out a research project in the study area. The title of the research is as follows:

Title of the Research:

Impact of ISO 9001 Based Quality Management System (QMS) on Project Performance of State Sector Construction Organizations in Sri Lanka

I am pleased to inform you that you have been selected to take part of this survey and kindly request your fullest participation and cooperation throughout the same.

It would be grateful if you could spend your valuable time to answer all the questions in this questionnaire, as it is directed. This questionnaire will be used for academic purpose only. It is designed as a tool for collecting primary data for the research.

I assure that this information will be kept confidential and only the summarized results will be provided in the report and therefore no specific reference will be made to experts who take part of this survey.

Thank you.

Yours faithfully,

L C K Karunaratne
M.Sc. Candidate
Mobile : 071-867-1185

Research Supervisor:

Dr. Lesly Ekanayake
Senior Lecturer
Department of Civil Engineering
Faculty of Engineering
University of Moratuwa
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QUESTIONNAIRE – PART 1

1 General Information

1.1 Name of the organization :

1.2 Gender of the respondent : Mr. ☐ Ms. ☐

1.3 Designation :

1.4 Working experience :

- Below 5 Years ☐
- Between 6 and 10 Years ☐
- Between 11 and 15 Years ☐
- Between 16 and 20 Years ☐
- Between 21 and 25 Years ☐
- Above 25 Years ☐

1.5 Exposure to the QMS activities within the working experience

- Below 2 year ☐
- Between 2 and 5 years ☐
- Between 5 and 8 years ☐
- Between 8and 10 years ☐
- 10 and above ☐

1.6 Respondent's level of contribution and involvement for the implementation and continual improvement of organization's QMS

- Low ☐
- Moderate ☐
- High ☐

1.7 Email :

1.8 Telephone / Mobile :

QUESTIONNAIRE – PART 2

This part of the questionnaire has two sub divisions namely 2(a) and 2(b) respectively. 2(a) will consist of questions in related with main clauses of ISO 9001:2015 and 2(b) is included with questions related with Key Project constraints (ie. Scope/Quality, Time, Cost) and Client's Satisfaction related to the research area. Respondents are requested to put their view on **To What Extent** these factors are satisfied in Construction Projects of State Sector Organizations. Please use 1-5 Likert-scale for indicating your opinion on the extent of use.

1= Strongly disagree
2= Disagree
3= Neutral
4= Agree
5= strongly agree

Questionnaire 2 – Part 2(a): Questions related to requirements of main clauses in ISO 9001:2015

2(a).1 Leadership & Planning (Clause No 5 & 6 of ISO 9001:2015)	**1**	**2**	**3**	**4**	**5**
1. Top management has shown their significant contribution to the effective implementation of QMS					
2. Top management is aware of the risk and opportunities of the business environment					
3. Established quality objectives help to meet customer satisfaction & continual improvement of processes					
4. Employees of the organization are aware about how they contribute to the achievement of the quality objectives					
5. Employees of the organization are clear on their duties, responsibilities and authority in meeting customer and regulatory requirements					

2(a).2 Support (Clause No 7 of ISO 9001:2015)	1	2	3	4	5
1. Required competencies for each positions have defined & strict to those requirement when recruiting new employees					
2. Base on training need identification organization provide sufficient training opportunities for all employees					
3. Organization is maintaining and continually updating required knowledge, information in relevant with their operation, processes, services					
4. Organization provides necessary infrastructure facilities that are helpful to achieving customer and regulatory requirements					
5. Organization provides a Work environment that are helpful to achieving customer and regulatory requirements					

	2(a).3 Operation (Clause No8 of ISO 9001:2015)					
1.	Avai1able documentation system help to adequately identify client's requirements & changes in client's requirements					
2.	Organization is much keen on the quality of products, works and services by the external suppliers					
3.	Available Measuring & monitoring equipment help to ensure the quality of constructions					
4.	In process & Final quality Inspection of the construction help to ensure that met customer requirements					
5.	Purchasing procedure & Incoming inspection help to ensure the required quality of raw material					
6.	Non-conforming products or out puts are clearly identified and controlled					

2(a).4 Performance Evaluation & improvement (Clause No 9 &10 of ISO 9001:2015)	1	2	3	4	5
1. Organization is monitoring and evaluate the performance and the effectiveness of the QMS					
2. Base Data analysis use as a tool for management decisions					
3. Internal audit helped to identify system deviation that can effect to the quality of construction					
4. Management review meetings are conducting according to defined periods & take effective decisions and actions regarding the QMS					
5. Corrective action procedure use as a tool to prevent recurrence of non-compliances and the organization continually improve the QMS					

Questionnaire 2 – Part 2(b): Questions related to Key Project constraints (ie. Scope/Quality, Time, Cost) and Client's Satisfaction

2(b).1 Effectiveness of QMS on Scope/Quality:	**1**	**2**	**3**	**4**	**5**
1. Scope of the project is identified adequately before implementation					
2. Amount of reworks to be done declined					
3. Non-conformities detected declined & Quality of works improved					
4. Improved capability to project scope statement, requirements documentation, and detailed project plan					
5. QMS is effective in achieving Project & Quality Objectives					
6. Accuracy and presentation of the work by improving quality assurance and control					
7. Helped to improve awareness of project objectives					
8. Identification, Correction and taking corrective measures were improved					

2(b).2 Effectiveness of QMS on Time:	1	2	3	4	5
1. Efficiency in meeting time targets & milestones were improved					
2. Delays in project completion was reduced satisfactorily					
3. Timely identification of issues and taking proactive measures were improved					
4. Factors affecting time delay could be easily identified and resolved					
5. Affect to the timelines by scope changes were minimized					
6. Scheduling and programming were improved & more realistic schedules could be achieved					
7. Reduction of delay, that are related of failure and shortage, and delivery of the materials					
8. Reduction of delay, as a result of lack of communication between parties involved					
9. Reduction of delay, as a result of unnecessary and without reason of inspections and testing					
10. Enhanced ability to anticipate project completion time, delay and its reasons					
11. A well-managed supply chain that provides a stable flow of goods and services to prevent delay					
12. Documented procedures are helpful to achieve time targets					

2(b).3 Effectiveness of QMS on Project's Cost:	**1**	**2**	**3**	**4**	**5**
1. To effectively resolve problems of construction on project with minimum changes to the project cost					
2. Business outputs are tracked and measured, which means areas of waste and reworks can be identified and reduced					
3. Increased ROI and profit could increase by optimizing the cost					
4. Optimizing performance can reduce expenses by efficient process management and resources					
5. Lower construction costs because of fewer nonconforming works, less rework, lowered rejection rates, streamlined processes and fewer mistakes					
6. A well-managed supply chain can reduce expenses					

2(b).4 Effectiveness of QMS on Client's Satisfaction:	**1**	**2**	**3**	**4**	**5**
1. Decreased in client's complaints					
2. Improved customers relationship, communication, and reporting					
3. Enhanced reputation of the organization and Brand image among the clients					
4. Increasing business benefits (ROI, NPV etc.)					
5. Improved customer loyalty					
6. Improved common understanding of goals and values among interested parties					
7. Processes are in place to track and resolve issues quickly and effectively					