Application of Quality Management Systems (QMS) in Construction Industry

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Abstract

The objectives of any project is always to achieve Minimum Operating Cost (within budget), Zero-Risk (maximum safety), Higher Productivity (on-time delivery) and Higher Quality of Product / Service (higher customer's satisfaction). Achieving such objectives requires the development of an effective and efficient Quality Management System (QMS). This paper will outline the basic requirements for developing such a powerful system and how construction engineers benefit from utilizing such a QMS. The paper will also provide a systematic approach of how to develop an affective and actually working QMS. Safety, Quality, Cost, Delivery and Morale (SQCDM) are the important aspects of successful construction project which fulfills the main goal of construction industry. The role of QMS for a construction company is not an isolated activity, but integrated with all the operational and managerial functions of the construction project. The quality management system (QMS) in construction industry refers to quality planning, quality assurance and quality control and cost and risk management.

Keywords
QMS, Quality Management Systems, Quality Procedures and Quality Standards, ISO 9001:2008 / 20015

INTRODUCTION

Quality Management System (QMS) is a collection of resources, organization, people and procedures that implement quality policy of organization. It clearly defines the expectations of customer's quality level. It ensures that incoming materials consistently meet processing and quality specifications. It ensures that correct and constant levels of quality are obtained through effective control of manufacturing or service operations. It ensures that procedures take care of any corrective action requests (CARS) needed to address sources of variation in materials, products or services. QMS is a total company wide philosophy. It is the planning, monitoring and control of the critical activities that have significant effect on: *Quality of product including service, hardware, software, process and materials or any combination. It is the Conformance to specifications level of efficiency of conformance to specifications.*

ISO 9001 is the internationally recognized standard for Quality Management Systems (QMS). It is the most widely used QMS standard in the world, with over 1.1 million certificates issued to organizations in 178 countries. It provides a framework and set of principles that ensure a common-sense approach to the management of your organization to consistently satisfy customers and other stakeholders. In simple terms;

- ✓ Say what we do
- ✓ Do what we say

- ✓ Record what we did
- ✓ Check the results
- ✓ Act on the differences

Objectives of QMS

To provide employees with an understanding of the basic ISO 9001 standards. Enhance the confidence of the customers in the quality system used by their suppliers. Establish a consistent and common language in dealing with growing and complex technology. Reduce costs associated with assessments and surveillance.

Why QMS is important for your organization?

It Provides shared documentation structure. Drives consistency in conducting business with customers. Increases customer's focus. Identifies areas of improvements. Provides methods of reporting major and minor nonconformance areas and implements the required corrective action (CA) plan. It also makes the process of learning a new job much easier and faster. It provides a clearly defined departmental procedures and work instructions. Provides and shares data and other information with other departments. Provides an easy and quick way to locate the latest version of the document or record.

General Elements of QMS

The following are general elements that must be addressed or included in the QMS for effective assessment and certification under ISO 9001:2008.

01. Resources
02. Responsibility and Authority
03. Performance Feedback
04. Quality Policy
05. Management Review
06. Business Plan
07. Assurance Plan
08. Use of Cross-Functional Teams
09. Training
10. Quality Planning
11. Purchasing
12. Contract Review
13. Delivery
14. Inventory
15. Continuous Improvement
16. Corrective and Preventive Action
17. Manufacturing Capabilities
18. Analysis and Use of Company Data
19. Customer Satisfaction
20. Assurance System Assessment
21. Document and Data Control
22. Customer Supplied Product
23. Product Information & Traceability
24. Process Control
25. Inspection and Testing
26. Inspection and Test Status
27. Handling, Storage, Packaging and Preservation
28. Control of Quality Records
29. Production Part Approval Process (PPAP)
30. Design Control
31. Control of Nonconforming Product
32. Statistical Techniques (SPC)
33. Preventive Maintenance
34. Control of Inspection, Measuring and Test Equipment
35. Employee Safety

36. Environment. However for simplification purposes, the 36 elements have been covered in only important 8 principles.

Figure 1.The Eight Principles of QMS (4)

Levels of QMS Documentation

1) Quality manual. The manual should fit your organization. The structure and the content of the manual can vary depending on the size of the organization, the complexity of operations, and the competence of the personnel. Small organizations can document the entire QMS in one manual. While, large international organizations may have several different quality manuals. Generally, the manual includes the QMS scope, exclusions from the standard, references to relevant documents, and the business process model. The quality policy and the objectives are part of the manual.

2) Quality policy. The Quality policy defines the quality objectives to which the organization strives. The quality goals of organizations are defined by quantifying the quality objectives. The Quality policy should state the commitment of the organization to quality and continual improvement. Usually, this policy is displayed in the organization's premises and posted on websites.

3) Quality procedures. Quality procedures can have different formats and structures. They can be narrative, i.e., described through text; they can be more structured by using tables; they can be more illustrative, i.e., flow charts; or they can be any combination of the above. Quality procedures should include the following elements:
Title, Purpose, Scope, Responsibilities and authorities of all people, Records that result from the activities described in the procedure, Document control, Description of activities Appendices may be included, if needed.

4) Work instructions. Work instructions can be part of a standard operating procedure (SOP). The work instructions include details of activities that need to be realized, focusing on the sequencing of the steps, tools, design specifications, assembly steps sand methods to be used and required accuracy. Quality records and forms, such as: Receiving, purchasing, warranty and repair, BOM, internal quality audits, repair order, inspection report and test data, may also be considered as level 5 in the QMS.

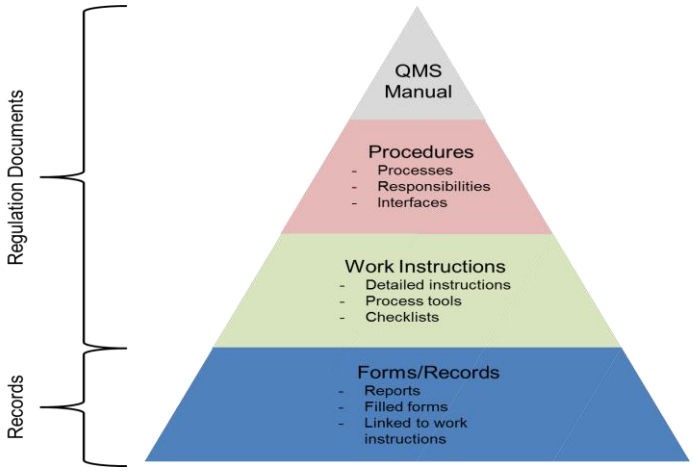

Figure 2 Levels of QMS (2)

The System Approach in QMS

To effectively and efficiently utilize and meet certification requirements of ISO 9001:2008, organization should adapt the systems approach of QMS. The four main clauses of the standard must be totally covered, namely, Management responsibility, Resource Management, Product realization and Measurement, Analysis & Improvement. This approach is well illustrated in Figure 3.

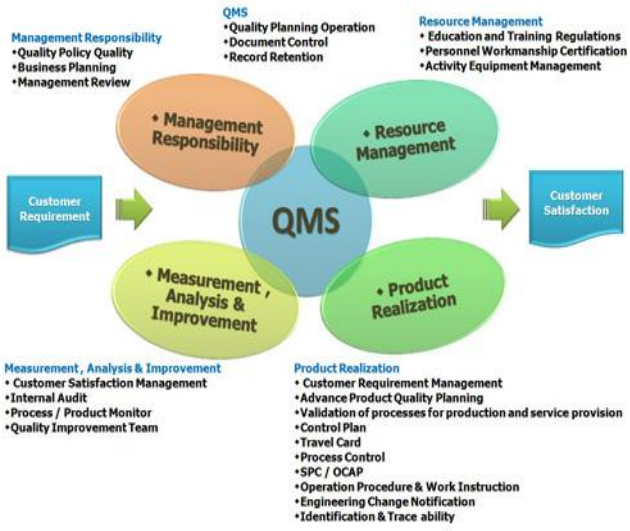

Figure 3. QMS System Approach (3)

Document Control

More than 90% of nonconformance to meet QMS requirements fall in the document control area. Therefore it is important for the organization to have effective document control system to pass the certification / registration audit.

Quality records should be:
Simple, properly identified, legible, easy to access, change and modify, complete, clear, correct, concise, accurate, available in electronic or hard copy.

Typical problems leading to poor documentation:
- ✓ Outdated version of procedures
- ✓ Inefficient process or procedures,
- ✓ Inaccurate or unavailable documents,
- ✓ Incomplete information on files,
- ✓ Changes have not been added to new documents,
- ✓ Unauthorized changes to documents,
- ✓ Undocumented changes to process, Product or delivery date,
- ✓ Undocumented "customer's satisfaction" reports,
- ✓ Unavailable "validation reports" for testing equipment

Preparing and Passing the Certification Audit
Organizations must conduct several internal audits to address any gaps or non-conformances in their QMS. They must make sure that their quality team follows the quality system model for continuous improvement (PDCA cycle). To pass the certification audit successfully, the Quality Team must understand their process, work instructions and documentation, advertise their strength, focus only on the right things, do not cover up or provide unnecessary information, remember that the audit is to check the effectiveness of the quality system not the team personal performance.

Figure 4. PDCA in the structure of QMS (4)

Important Clauses in ISO 9001:2015
ISO 9001:2008 has been updated with a new major changes to develop the new ISO 9001:2015. These changes will mark the first major rewrite to the ISO standard since 2000. The newly developed ISO 9001:2015 is now officially published and many organizations are adopting it. ISO 9001:2015 will include several major changes which will affect not only organizations developing and implementing a certified Quality Management System, but for those already registered as well. Once released, organizations will have three years to transition over to the new standard, with full implementation to be completed by September 2018.

Major Changes in the Recently Implemented ISO 9001: 2015

The Most notable changes are, the eight clauses of ISO 9001:2008 have been expanded to ten with the ISO 9001:2015 standard. This expansion incorporates an increased emphasis being placed on **risk based thinking** and building that into the organization's Quality Management System, along with a greater management involvement in the Quality Management System. Table 1, illustrates a comparison between ISO 9001: 2008 and ISO 9001: 2015.

TABLE 1. COMPARISON between ISO 9001:2008 and ISO 9001:2015

	ISO 9001:2008	ISO 9001:2015
Section 1	Scope	Scope
Section 2	Nominative References	Nominative References
Section 3	Terms & Conditions	Terms & Conditions
Section 4	QMS	Context of the Organization
Section 5	Management Responsibility	Leadership
Section 6	Resource Management	Planning
Section 7	Product Realization	Support
Section 8	Measurement, Analysis & Improvement	Operation
Section 9		Performance Evaluation
Section 10		Improvement

Benefits of implementing ISO 9001:2008 or ISO 9001:2015 Standard in QMS

The ISO 9000 series outlines all aspects of quality management systems. The ISO 9001:2015 sets out the basic requirements of a quality management system. The most popular and established global management standard, ISO 9001 is adopted by over one million companies in 176 countries worldwide. It is an important tool for enhancing your company's success, profitability and market potential. It will add a positive effect on investment, market share, sales growth, sales margins, competitive advantage and avoidance of legal issues and damaging litigation. Effective implementation of the standard will yield the following benefits:

1. A customer focused organization
2. Leadership
3. The involvement of people
4. Ensuring a process approach
5. A systematic approach to management
6. A factual approach to decision making
7. Mutually beneficial supplier relations
8. Continuous improvement
9. Customer satisfaction.
10. Reduced operating costs.
11. Improved stakeholder relationships.
12. Legal compliance.
13. Improved risk management.
14. Proven business credentials.
15. Ability to win more business.

Specific Benefits of the New ISO 9001:2015

- ✓ Greater emphasis on Leadership engagement
- ✓ Addresses the organization risks and opportunities in a structure manner
- ✓ Uses simplified language and a common structure and terms
- ✓ Utilizes Supply Chain Management more effectively
- ✓ More User-friendly for service and knowledge based organizations
- ✓ Creating a more efficient, effective operation, including cost containment and savings
- ✓ Increasing customer satisfaction and retention
- ✓ Promoting employee motivation, awareness and morale that leads to a high level of customer service
- ✓ Optimizing your market potential and opening your business to larger clients, both at home and abroad
- ✓ Promoting international trade
- ✓ Improving consistency and information flow

- ✓ Reducing negative impacts on the environment

Adaptation of QMS in Construction Industry

It is estimated that in 2014 that 10% of its total fiscal market was attributed to the construction and building industry. Given the value of this sector to the greater economy, there are several accreditation schemes available to companies working in this field, the standard is focusing mainly on safety and environmental considerations, quality and cost are extremely important to both the builder and the customer. The government increasingly involved supervision, customers are becoming more educated and demanding, often getting directly involved in projects themselves. Delegated responsibility plays an increasingly prominent role in infrastructural civil engineering and building projects Utilization of the standard in construction industry will provide you with the following major benefits:

- ✓ Standardize services and product quality:
- ✓ Reduce costs for the builder:
- ✓ Ensure continual improvement:

Companies in the construction sector, will have to satisfy all clauses of the ISO 9001 standard to become accredited (Certified), there particular parts of the standard that would specifically help the performance of a construction sector company? These are:

- ✓ Planning:
- ✓ Supply chain management:
- ✓ Performance evaluation:
- ✓ The process approach:
- ✓ Leadership:
- ✓ Win new customers:

CONCLUSIONS

QMS is the quality system of that clearly defines the expectations of the customer's quality level. It ensures that correct and constant levels of quality are obtained through effective control of design, development, manufacturing or service operations. Organizations will have a higher priority of obtaining contracts in conducting business with their customers, since they have an effective and efficient QMS in place. An effective and actually working QMS is an indication of the organization's commitment to Safety, Quality, Delivery, Cost and Morale. Global market requirements and governments are enforcing strict laws of Safety, Environment, Quality and Ergonomics, construction industry is changing the way it operates by applying effective and efficient QMS in their business. The new ISO 9001: 2015 is their only vehicle to surviving in our continually changing global market.

REFERENCES

1. Application of MQAS, http://www.northlink.co.za/Qms.aspx
2. Writing Policies & Procedures, Greg Babb, Textlogic, May 13, 2014
3. ATTG Management System, http://www.attg.co.th/index.php?p=MgtSystem
4. MQAS Application for Chrysler, Automotive Assembly Plants, Dr. Daw Alwerfalli, Chrysler, 2006
5. John Nolan, Would construction companies benefit from ISO 9001? June7, 2016 http://advisera.com/9001academy/blog/2016/06/07/
6. AbdulAziz A.B. and Tawfiq, H.A. (1999). ISO 9000 Quality Standards in Construction, Journal of Management in Engineering, Nov/Dec, pp. 41.
7. Integration of Safety, Health, Environment and Quality (SHEQ) Management System in Construction: A Review. Jurnal Kejuruteraan Awam, Vol 16(1): 24-37, pp. 14
8. Lydia (2010). The Integration of Quality Management System in Construction Industry. Submitted version Master's Thesis, Universiti Teknologi Malaysia, Abdul Hakim and Mat Naim (2006) Integration of Safety, Health, Environment and Quality (SHEQ) Management System in Construction: A Review.
9. Quality Standard, What is ISO 9000 and ISO 9001 (2008), pp. 1-2. Retrieved November 2, 2011 from http://www.dennemeyer.com/content/en/quality-standard.html

Biographies

Dr. Daw Alwerfalli

Professor of Mechanical / Manufacturing Engineering, senior technical industry consultant and manufacturing engineering educator with a tremendous expertise in program and curriculum development in higher technical education. Highly experienced and dedicated community leader. Highly perceived expert and industrial advisor, driven to acquire and apply industry proven standards, practices, and methodologies to offer the best possible solutions that improve, productivity, quality, performance and reliability while reducing costs. Dr. Alwerfalli is appointed by the governor of Michigan to serve on his advisory board and to lead the steering committee for higher education assessment for MAT2 for the DES program for the state of Michigan since 2012. He served on Chrysler AME team as a senior technical advisor between 1995 and 2008, the team saved Chrysler millions of dollars solving chronic manufacturing problems in automobile assembly and tooling. He has several publications in national and international conferences in the areas of Lean Manufacturing, Continuous improvement, robust design, DFA, DFM, QMS and others. He advised many doctoral students in the DEMS at LTU, most of them are currently leaders in US industry. Dr. Alwerfalli obtained his BSME from University of Tripoli, MS in Textile Engineering from Georgia Tech., ME in Manufacturing Systems from University of Detroit, Doctor of Manufacturing Engineering from University of Detroit. He is the founder and CEO of Manufacturing Engineering Solutions, a consulting firm in Dearborn USA provided consulting and training services to Chrysler, Ford, GM, TRW, JCI, WELDMATION, MAX, Quad Industries, EXXON Mobil, CONCO Philips, MARATHON Oil, AVA group and many others.

Dr. Aslihan Karatas

Dr. Karatas received her PhD in Civil Engineering from the University of Illinois at Urbana-Champaign, her M.S in Civil Engineering from University of Florida, and her B.S. in Civil Engineering from Bogazici University, Turkey. She also worked one year as a postdoc at Civil Engineering Department in the University of Michigan, Ann Arbor before joining Lawrence Tech. University. Her specialization is in construction engineering and management with an emphasis on sustainable construction, building energy efficiency, and optimization and decision-making analysis in construction. She was also involved in DOT projects in Florida and Illinois. Dr. Karatas is a member of ASCE, Chi Epsilon, and Society of Women in Engineering.

Muteb Alshammari

Muteb is currently a senior student pursuing his BS in Civil Engineering with emphasis on Construction Management. He is expected to complete his BSCE in spring 2017. He is current academic goal is to obtain a Master of Engineering Management. He has published technical papers in Civil Engineering in international conferences and Journals.