CASE STUDY

Quality Management System Implementation in Engineering & Construction
QUALITY MANAGEMENT SYSTEM IMPLEMENTATION IN ENGINEERING AND CONSTRUCTION

by

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INTRODUCTION

This paper is based on experiences of the author involved in the ISO 9001 Quality Management System implementation in one of the largest engineering and Construction Company of Pakistan. The company involves itself in the following construction related activities:

- Project Management
- Construction
- Engineering
- Manufacturing
- Procurement
- Erection
- E & I Installation
- Commissioning & Turnarounds
- Operation & Maintenance

The main construction areas being:

- Power & Energy
- Infra-Structure
- Process Industries
- Oil Refineries
- Fertilizers
- Chemical Plants etc.

Convinced of the immense advantages, the top management of the company decided to earn ISO 9001 certification through a company wide process of Quality Management system implementation.

The company vision that evolved for this process of change said:

By applying Quality Management Systems, we intend to achieve a high standing of the company so that we may have:

- Undisputed Leadership in Engineering & Project Management.
- Providing Solutions and Services with High Level of Professionalism.
- Profitable Growth.

The process followed a well-planned 20-step course up to certification.

STEP– 01: DECLARATION OF THE QUALITY POLICY

The HRL Quality Policy was declared by the Board-of-Directors clearly and concisely. The policy words were so chosen as to depict internal and external customer satisfaction and QMS principals:
Salient features of the policy were:

- Understanding that quality means complete conformance to agreed customer requirements & standards.
- Understanding that quality is everybody's direct responsibility.
- Putting our best effort every time for in-time completion of job, not compromising on quality & safety.
- Continuous improvement in skills and know-how through practical experience and training of the people.
- Operating all our work places in a safe and healthy environment.
- Fulfilling our promises and commitments with the Client.

It was also vouched that the company should be dedicated to this mission; “Our reputation depends on all of us working as a team to satisfy and retain the single most important person in our business, that is … OUR CLIENT.”

This policy was translated by our top management into clear aims and objectives, to result in:

- Organizational Improvement.
- Foundation for an organized system for Quality Assurance.
- To set course for TQM.
- Reduction in product rejections, reworks and customer's dissatisfaction.
- Survival in the Market.
- Better equipped to compete.
- Gaining customer confidence.
- Have an edge in the market.

STEP– 02: APPOINTMENT OF A MANAGEMENT REPRESENTATIVE

The QMS programme needed organizing and steering for which the management entrusted this responsibility to the senior most General Manager to act as the “Management Representative” (MR).

By virtue of his clout in the company he spearheaded the QMS implementation conforming to ISO 9001, 1994(E) standard, covering Engineering, Procurement & Construction activities.

STEP-03: APPOINTMENT OF A QMS CONSULTANT

Not much was known and understood by the company management about ISO 9001 standard and the way to proceed with QMS implementation in the company. Therefore, the appointment of a suitable consultant was agreed upon. After due consideration for experience, expertise, knowledge and economy a consultant was contracted to help advise, guide and implement the programme.

STEP-04: THE ISO TEAM
For executing the programme, MR formed an ISO team from within the staff to act as ISO co-ordinators. The ISO team in conjunction with the consultants prepared the first draft of the Quality Manual (later called the Corporate Quality Manual"). The manual philosophy was based on making Work Procedures pertaining to each of the 20 clauses of the ISO 9001 standard.

Some months passed before it was realized that for a construction company of the size and diversity of sites, needed a full time Quality Assurance and Quality Control department to handle QMS implementation and control the quality of products at sites.

STEP-05: UNDERSTANDING THE COMPANY CULTURE

People make up an organization. These same people belong to diverse backgrounds and possess different ideas. Once they intermingle in a common work environment, they form a working culture known as an “organizational culture”.

The company had grown to what it is today from the hard work of a few humble owners in a small setup. In olden days the day to day construction work was carried out with the help of a deputy or munshi, who took care of the accounts, manpower, material arrangements and services as may be required during the course of work or personal life of the owners. This arrangement was the management as we define today.

As the company grew to handle greater volumes of construction work and come across foreign clients, qualified and experienced management was inducted for engineering, construction and project management. Clarity of vision and decision making at corporate level improved and helped the company to vie for an organization of standing in a very promising market at the time.

It was also understood that company cultures do not improve to meet modern day corporate challenges because of a few individuals. Rather, it is the cross-section of the organization starting from the BOD down to the office boy, who should adopt a systemized approach to the way work is done and results achieved in an organization. This positive cultural indicator was not apparent in the core of company’s culture, a challenge to tackle under the QMS and stays such, even today.

How did the company go for ISO 9001? The answer lies with the BOD getting convinced of the advantages of a QMS based on ISO standards. Secondly, the government imposed the ISO 9000 criterion for Pakistani companies to qualify for surviving in an ever-competitive international market.

To a QA manager, it required insight, study and analysis to pinpoint the company culture before proceeding with the QMS implementation programme. Knowing about this culture was important before a strategy could be evolved to proceed with the QMS program. GAP analysis was one answer. But failed, as it was formal and not many responded. This situation was corrected through education and training later.

STEP-06: FORMING A STRATEGY

At the onset, the MR and his QA team confessed that the programme implementation within the company culture would be a very difficult task. The second
apprehension was that construction activities were not geographically localized and consisted of widely spread out construction sites. Thirdly, the sites were known to have a continuous turnover of workers, supervisors and managers. Fourthly, the QMS implementation program had a budget constraint.

To rout these difficulties a great amount of man-hours were spent brain-storming. A number of plausible paths were strategized and planned. Considering all odds a strategy was formulated with the following salient features:

a. Re-structure the organization to a suitable form consisting of the Board-of-Directors, Head Office management and the Site management.
b. Quality Management System and orientation & training of basic concepts.
c. Analysis of company processes that qualitatively effect management and products delivered to clients.
d. Deciding the hierarchy of Quality Management System documents.
e. Finalizing the company quality manual.
f. Formation and training of an Internal Audit team.
g. Education, training and counseling to departments and sections at H.O and Sites for implementing QMS.
h. Internal Audits.
i. Corrective and preventive action cycles.
j. Statistical analysis of management system implementation and quality of products.
k. Management Review meetings.
l. Preparation for pre-audit and certification audit.

**STEP-07: RE-STRUCTURE THE ORGANIZATION**

The company’s organizational structure had anomalies requiring streamlining under the QMS concepts.

Firstly the existing structure was analyzed, debated, adjustments made and a structure confirmed by the Board of Directors. This structure gave the company a corporate organogram, which was comprehensive as well as flexible enough to accommodate changes. For this, the Corporate, departmental and sectional organogram review and verification rule was defined and implemented according to the company hierarchy.

To bring in an equal opportunity culture, designations were based on functional positions rather than appointments. Each department in-charge was designated as the Head of Department and his responsibilities and authorities clearly defined in the form of job-descriptions.

**STEP-08: QUALITY MANAGEMENT SYSTEM ORIENTATION & TRAINING**

At the onset, not many managers in the company understood QMS under ISO 9001 standard. Orientation and training was done for the ISO 9001 standard and its translation into QMS concepts and procedures.

It is pertinent to mention here that at these early stages of our system buildup, our ISO consultants imparted extensive training and education along the length and
breadth of the organization. Their services for orientation and training on various QMS subjects came to be extremely useful during in-house and external sessions.

STEP-09: ANALYSIS OF COMPANY PROCESSES

This being an engineering and construction company, its processes evolved from two main processes i.e. Project Acquisition (Marketing & Estimations) and the Project Execution & fulfillment process (Project Management).

Project Acquisition process involved the following sub-processes:

a. Business Development.
b. Proposals or Estimations.

On successful acquisition of a Project, the Project execution & fulfillment process would start, consisting of the following sub-processes.

a. Designation of Project management.
b. Project Organization.
c. Determination of Project processes.
d. Determination of Project specifications and standards.
e. Project Mobilization.
f. Project Quality Plan.
g. Project Planning.
h. Procurement & Stores.
i. Calibration of IMTE.
j. Inspection & Test Plan (ITP).
k. Safety, Health & Environment.
l. Process Validation.
m. Quality Audits.
n. Project Monitoring & Control.
o. Workmanship and skill.

These sub-processes were considered critical and care was taken to effectively cover them in the Quality Manual and documents.

STEP-10: HIERARCHY OF QUALITY MANAGEMENT SYSTEM DOCUMENTS

Quantifying the QMS documentation under the ISO 9001 standard meant the company to traditionally make its:

b. Work Instructions.
c. Quality Records or formats.

For a Project Management company, the traditional approach to QMS documentation meant extensive paper work in the form of procedures, work instructions and quality records.
Quality documentation at the corporate level needed to be predominantly a policy document, structured to accommodate all clauses of ISO 9001. Since many processes at the corporate and site levels had to be contained in this single manual, therefore two manuals were structured:

a. Quality System Manual: A compendium of the QMS to be followed at the corporate level based on ISO 9001 standard clauses.

b. Corporate Quality Manual: A manual giving detailed procedures for activities at the corporate level and a guideline for site activities and documents.

It was also understood that every time a project was awarded, project specific documentation had to be made for the site in accordance with the client requirements. It was also not necessary that the scope, structure and resources of different sites shall match. Special processes and requirements were known to crop up at different stages of projects requiring a more flexible working manual for the site.

Considering the above facts it was decided that a project specific “Quality Plan” or procedures manual was required to be made under the guidance of the CQM (and clauses of ISO 9001 standard) every time a project was mobilized. Project specific quality documents, specifications and records formed the basis of such a plan called the “Project Quality Plan”.

The quality document hierarchy in the company evolved as in Fig. 01:
STEP-11: COMPANY QUALITY MANUAL.

With the structure of QMS documentation decided, preparation for the Corporate Quality Manual commenced. A dedicated team prepared the first draft of the CQM, which specified policies and procedures for critical activities imbibed with the 20 clauses as directed by ISO 9001 standard.

The CQM was reviewed through a Management Review Meeting and approved by the MR for promulgation in the company as Issue 01. The document and data control procedures as defined in the manual were followed.
STEP-12: EDUCATION, TRAINING AND COUNSELING

The system was required to be installed in the company and needed promulgation through education, training and counseling. Here I must mention the training and education imparted firstly by our QMS Consultants and secondly by our dedicated QA team. The methodology was to carry out group and individual sessions at Head Office and Sites to convey, discuss and clarify about the Corporate Quality Manual and Project Quality Plan contents. Shortly, the QMS manuals were being opened, consulted, procedures discussed and used. Specified formats and their flow within departments started and the advantages acknowledged. This was the time to start our internal audit preparations.

STEP-13: PREPARING THE INTERNAL AUDIT TEAM

Quality Assurance does not happen, it is done. Therefore, to gauge its degree of implementation within an organization, Internal QMS Auditors are required.

Formal training is essential to correctly align individuals for carrying out internal audits in a company. Hence, individuals with sufficient management and technical capabilities were selected for undergoing such formal training. On qualifying, the Internal Auditors showed appreciation and clarity about QMS and acquired an “auditing discipline”, an important aspect for matured auditors.

An internal audit team was formally declared in the company to carry out a well-coordinated series of internal audits covering the company Head Office departments and the Construction Sites.

STEP-14: INTERNAL AUDITS

These internal audits gave the QA team an idea of the state of QMS implementation. It was also a good idea for the company to invite the QMS consultants to carry out internal audits to gauge non-conformances from an outsider’s point of view and give us expert solutions for corrective and preventive actions.

The non-conformances gauged during internal audits were called “System Non-Conformances” (SNC) and analyzed periodically for trends.

STEP-15: INSPECTION & TESTING

The quality control aspect of the ISO 9001 standard required that the product non-conformances are gauged and their corrective and preventive actions followed up at the execution level. Monitoring of the actions was required at the corporate level.

The product specifications were taken as the conformance and acceptance criterion for the QC field teams at sites to originate non-conformance reports in case of
detecting one. The corrective & preventive action was verified at sites and the disposition monitored at the corporate level (QA department).

The non-conformances gauged on a product during field QC inspection and testing were called “Non-Conformance Reports” (NCR). These were analyzed for conformance, categories and trends.

**STEP-16: CUSTOMER COMPLAINTS**

The ISO 9001 standard dictates that, complaints arising out of the company’s interaction with clients, management practices, services and product quality be addressed through a preventive and corrective action cycle.

These complaints could be conveyed to or detected at any organizational level, coming in contact with a customer. The complaint is appended onto a “Preventive & Corrective Action Report” (PCR) format with a consequent corrective and preventive action flow. Disposition of these reports are monitored at corporate level.

**STEP-17: CORRECTIVE AND PREVENTIVE ACTION CYCLES**

All the three types of NC reports / Complaints i.e. SNC, NCR and PCR were followed by preventive and corrective actions according to the following general sequence:

a. Explanation of the NC was clearly annotated onto the relevant format by the internal auditor for SNC, QC Inspector for NCR and any one for a PCR. This report was then formally given to the auditee.

b. Examination of the “Root Cause(s)” was done by the auditee / responsible function and appended on the format.

c. The auditee/responsible function decided on a corrective and preventive action (to avoid reoccurrence) and fixed a target date for compliance, on the format. Format / NC log then made its way to the QA department for verification / monitoring disposition.

d. The QA auditor/QC inspector verified the corrective & preventive action taken on or after the target date. If verified, the NC was closed. If not, then a new target date was given.

e. A NC log was maintained with the QA department to monitor and control the corrective and preventive action process.

f. Results were analyzed and discussed during the Management Review meetings for highlighting the state of QMS compliance. Chronic NCs or anomalies were discussed and solutions found.
The above six-step cycle was repeated for the purpose of bringing about reduction in the number of non-conformances within a targeted time frame. The corrective & preventive action cycle can be illustrated as in Fig. 02.

During this cycle counseling and guidance to the auditee played an important part. The QA team involved itself in the corrective and preventive process where necessary. Thus, a sense of cooperation prevailed and company personnel showed conviction to contribute towards the process of change. The number of NCs steadily declined with the passage of time and was brought to a minimum acceptable number before each internal audit through the C & P Cycle.

It is must be confessed here that the carrot and stick approach was used. This was necessary for some impeding areas due to cultural aspects. These areas were brought to conformance status through drastic structural changes.

**STEP-18:** **MANAGEMENT REVIEWS**

Management Reviews are a process of reviewing the extent of QMS implementation in the company. The review sessions must at least be chaired by the Management Representative (MR) periodically and meaningfully.

The review sessions were either separate reviews for tackling selective matters, or collective Management Review Meetings where all QMS participants attended. The status of the QMS was discussed and reviewed according to its implementation stage and decisions made. Matters related to the corrective and preventive actions were specially discussed for moving the process of implementation forward.
These sessions were carried out both at the H.O and sites. We were fortunate to have members of the BOD attend some of these sessions.

**STEP-19: STATISTICAL ANALYSIS**

Compliance or non-compliance of QMS processes is measurable once the system processes are defined in the manuals and plans. These measurements were tabulated and statistically analyzed to know QMS conformance. The QA department compiled data and statistically transformed it into usable results. These results were as follows:

<table>
<thead>
<tr>
<th>DATA</th>
<th>ANALYSIS</th>
</tr>
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| a. SYSTEM NON-CONFORMANCES (SNC). | • No. of SNC’s opened in an audit.  
• Total no. of SNC’s till today.  
• Nos. closed / un-verified & open.  
• No. of SNC’s Department wise.  
• ISO 9001 clause wise. |
| b. NON-CONFORMANCE REPORTS (NCR). | • Weekly opened and closed.  
• Cumulative opened and closed.  
• Categories of NCs (Out of 35 cats.).  
• Trend. |
| c. PREVENTIVE & CORRECTIVE REPORTS (PCR). | • Root Causes.  
• Areas of Complaints.  
• Trend. |

By-and-by the planning for QMS implementation was based on some of this analysis.

**STEP-20: PREPARATION FOR THE PRE-AUDIT AND CERTIFICATION AUDIT**

It is recommended and considered standard practice for a company to offer itself for an external pre-assessment or pre-audit before the final certification audit. This is desirable for the company to have an un-biased opinion about its QMS implementation.

Months earlier we had invited quotations from various certification bodies from in country & abroad. Accreditation Certificate of each certification body agency was asked and scrutinized. After confirmation of their credibility, capability and economics, a comparative process led us to the selection of a certification body. The pre-audit time period was mutually agreed.
The ultimate test for the QMS implementation was going to be our ability to show compliance to the ISO 9001 standard. The assessment audit was a grueling four-day affair covering our Head Office and a large construction site in mid-country.

The process and method of an assessment audit is the same as that of the final certification audit. Considering good performance at the final stages of the audit and our evaluation of the fact that no major or minor non-conformance has been noted, the company decided to request the auditors to convert this assessment audit into a final audit. This kind of request is allowed under the certification system. The auditors after receiving our request chose to hold their decision till announcement of the results.

The announced certification audit results were in favor of the company with some observations and no system non-conformances. The audit was declared as a final certification audit and the company QMS found adhering to the system requirements of EN ISO 9001:1994 standard.

It was indeed a moment of joy for a well deserved result, an outcome of persistence, hard work and a desire to change and progress.

**DIFFICULTIES**

The above steps to certification are to give you a broad outline of a do-it-yourself methodology. This methodology would not be of substance if the encountered difficulties were not narrated for your benefit:

- The BOD / Top management could not be assembled at a time to discuss and formulate the company Quality Policy. As a consequence, the ISO team had to draft the Quality Policy and individually coordinate with the MR and the BOD for finalization.

- Initially, there was no awareness amongst most of the management functions about ISO 9000 standard and their role in the QMS.

- A number of management functions refused to accept the QMS under ISO 9001. For some, it was a resistance against change. While for others, it was a resistance against accountability.

- Lack of participation by the management in the implementation processes. This was mainly witnessed during the phase of documents & procedures making. Giving a low priority to the QMS as compared to their other responsibilities was the reason.

- The unique conditions at each of the sites and their pre-occupation with execution made them less receptive towards QMS implementation and avoided any disturbance in their working habits.
Attendance during orientation seminars and training sessions was poor. Many did not care to attend and those who did were irregular and developed mutilated concepts. This was put right by organizing planned sessions in each department and section (…and holding a stick).

The Management Representative was also the chief executive of the company who’s availability caused MR meetings to be postponed off and on. This was not desirable and lessened impact on the preventive and corrective action cycle.

The making of non-conformances on the QMS (QA), products (QC) and customer complaints (PCR) were usually taken as a personal complaint against the auditee, executor or management function. This occasionally resulted in unpleasantness.

Traditional QC at sites was usually confused with QA, due to which the usual cribbing and complaints against QC targeted the QMS also.

The ISO team was dubbed as a temporary setup with no productivity and earning.

It is pertinent to mention that most of these difficulties were caused due to the company culture, ignorance about QMS and vested interests. However, they were overcome with consistency, tact and training/counseling. Lessons were therefore learnt, which are appended below for your benefit:

**LESSONS LEARNT**

Considering the above, many lessons could be learnt. However, I would like to summarize those which are pertinent to the task of implementing a QMS:

- Company Quality Policy must be realistic and achievable.
- MR must have clout in the company.
- Select and employ a competent and aggressive QA team.
- Appoint a competent QMS consultant.
- Analyze the company culture and keep it in perspective while forming a strategy.
- Base the company structure on processes owned by the company. Do not create new ones, until necessary.
- Include all in the initial orientation & training, specially the top management.
- Keep the QMS document hierarchy logical and simple. Consciously avoid over-documentation.
- Training is formal, but counseling is personal and it works.
- The corrective and preventive action cycle is difficult to establish. Be persistent.
- Focus of Statistical Analysis should be towards greater productivity rather than QMS alone.
- Select an external auditor with credibility and reputation.
- Prepare the organization for “no-surprises” during the certification audit.
CONCLUSIONS

As presented above, from inception to certification, QMS implementation based on the ISO 9001 standard is a systematic process. This process is by no means exhaustive for all categories of engineering & construction setups. The general road to implementation could be along these steps, provided, companies decide on their vision, mission and QMS objectives prior to start of their programme.

Participation and teamwork must be encouraged in the company to bring about a transformation in company’s culture. In this context, the role and participation of the H.O and site teams be emphasized. Their positive contributions should be recognized and encouraged.

In the form of ISO 9001 certification, our company took the first step towards TQM, for which the improvement cycle goes on. ISO 9001:2000 (Year 2000 draft) shall be our next stepping stone. Self-Assessment and quality through HRD shall be strengthened and emphasized for all business units and departments of the company.

THE AUTHOR

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In the private sector, served the engineering and construction industry in quality assurance & control. Especially, in the implementation of ISO 9001 based Quality Management Systems in some of the largest engineering & construction companies of Pakistan. Introduced to the private sector, reliable services for calibration, maintenance and repair of Inspection Measuring and Testing Equipment.

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