4.0. INTRODUCTION

Organisations of various types situated throughout the world have nourished the benefits of management system in TQM Programmes by installing ISO 9000 series quality system models. During the last three decades, ISO 9000 series system models have been widely applied across a range of organisations which range from engineering to textiles, from chemicals to food, and increasingly in non-manufacturing sectors including banks, insurance companies, hotels and colleges for further education, many organisation opined that ISO serious standards stipulations are highly generic and realise the need of bringing out stringent standards for their quality systems. In coincidence to this developments, in June 1988, representatives from the three automotive original equipment manufacturers (OEMs) and Automotive division of the American society for Quality Control (ASQC) created the Supplier Quality Requirements Task Force to develop a common understanding on topics of mutual interest within the automotive industry. In August 1994, the task force developed and released Quality System Requirements: QS 9000, which is a common set of requirements for all automotive suppliers. QS-9000 defines the fundamental quality requirements of the big three automakers (General motors, Ford, and Chrysler), truck manufacturers and other subscribing companies. Since QS 9000 is more specific in comparison to ISO9000 serious standards, it was thought that a QS 9000 based maintenance quality system based would be an useful contribution in SMQE model.
4.1. MAINTENANCE QUALITY SYSTEM AND QUALITY SYSTEM STANDARDS

While it is alarming to observe that many innovative manufacturing philosophies including TQM are reported to have experienced failures (Gravin, 1995), a perusal on literature (Murugesh et al., 1997) indicates that the absence of models that are compatible to the current needs is found to be a major cause of such failures. Hence installing maintenance quality system, which will have no impact or significance in the current manufacturing trend would lead to failures. At this juncture, a need arose to develop maintenance quality system based on QS 9000. However study of the recent trend indicates that manufacturers are of the opinion that ISO 9000 series models are lenient with regard to attainment of quality. As a matter of fact, the interest among manufacturers towards implementing ISO 9000 series models of quality system has reduced to a greater extent. Meanwhile, many companies have started to evolve their own standards by keeping ISO 9000 series standards as base. The recent outbreak in this direction is the emergence of QS 9000 quality system standard. Four American companies namely Ford, General Motors, Chrysler and Truck Manufacturers have formulated this standard. Though the penetration of QS 9000 quality system models in present day manufacturing is not very effective, casual and informal interviews with personnel from companies which adopted QS 9000 model, hinted that this model provides better solutions for quality improvement. Hence, it can be anticipated that in place of ISO 9000 series models, in future, enterprises would try to adopt QS 9000 model. After realizing this trend, it was decided to explore the feasibility of adopting QS 9000 standard for design and installation of maintenance quality system. Such a system shall encompass a policy,
procedures, records and work instructions, customer and sector specific requirements, which would aid in attaining continuous improvement of maintenance quality.

4.2. DESIGNING MAINTENANCE QUALITY SYSTEM

In this section the stipulations of maintenance quality system model designed by referring to ISO 9000 standard are presented.

4.2.1. Maintenance quality policy

The supplier management with executive responsibility shall define and document its policy for maintenance quality, including objectives for maintenance quality. The maintenance quality policy shall be relevant to the supplier’s organizational goals, expectations and needs of its customers. The suppliers shall ensure that this policy to be understood, implemented and maintained at all levels of the organization.

4.2.2. Responsibility and authority

The responsibility, authority and interrelation of personnel who manage, perform and verify the work affecting maintenance quality shall be defined and documented.

- Initiate action to prevent to the occurrence of any nonconformity relating to the product, process and quality system.
- Identify and record any problems relating to the product, process and quality system.
- Initiate, recommend or provide solutions through designated channels.
- Verify the implementations of solutions.
- Control further processing, delivery or installation of nonconforming products until the deficiency or unsatisfactory conditions has been corrected.
There are four principal ways in which responsibilities and authority can be defined and documented:

➢ In an organisation structure diagram.
➢ In job descriptions.
➢ In terms of reference.
➢ In procedures.

4.2.3. Resources - Identifying and providing adequate resources

The suppliers shall identify resource and provide adequate resources including trained personnel for management, performance of work and verification activities including internal audits. The resources normally include time, manpower, machines, materials, finance, plant and facilities, in fact any means available to the supplier for implementing the maintenance quality system.

4.2.4. Management representative

The supplier’s management with executive responsibility shall appoint a member of the supplier’s own management who is responsible of other responsibilities, shall have defined authorities for

➢ Ensuring that a quality system is established, implemented and maintained in accordance with QS 9000.

➢ Reporting on the performance of the maintenance quality system to the supplier’s management for the review and as the basis for improvement maintenance quality system.

In addition, the management representative has the right to:

• Manage the design, development, implementation, and evaluation of the maintenance quality system including the necessary resources (the management role).
• Determine whether proposed policies and practices meet the requirements of the standard, are suitable for meeting the business needs, are being properly implemented and cause noncompliance to be corrected (the regulatory role).

• Determine the effectiveness of the maintenance quality system (the analysis role).

• Report on the maintenance quality performance of the organisation (the scorekeeper role).

• Identify and manage programs for improvement in the maintenance quality system (the innovative role).

• Liaisons with external bodies on maintenance quality affairs (the role of ambassador).

4.2.5. Management Review

The supplier’s management with executive responsibility shall review the maintenance quality system at defined intervals sufficient to ensure its continuing suitability and effectiveness in satisfying the International Standard. This management review requirement shall include all elements of the entire maintenance quality system.

The management review should do several things:

• Establish whether the system is being used properly.

• Establish whether the audit program is effective.

• Establish whether customer needs are being satisfied.

• Establish whether the defined maintenance quality objectives are being met.

• Establish whether there is conflict between the stated maintenance quality policy, the maintenance quality objectives, organisational goals and expectations and needs of the customers.
• Establish whether the system requires that any change to match the changing
business needs.

4.2.6. Business Plan

The supplier shall utilize a formal, documented, comprehensive Business plan. Goals and plans should cover short-term (1 to 2 years) and long term (3 years or more). The goals and planning should be based on benchmarking inside and outside industry and the supplier's commodity. These plans should cover the customer present future satisfaction.

4.2.7. Analysis and use of company level data

The supplier shall document trends in maintenance quality, operational performance (Productivity, performance and efficiency) and current maintenance quality level for key product and service features. The trend in data and information should be compared with progress towards overall business objectives and transferred into actionable information.

4.2.8. Customer satisfaction

The supplier shall have a documented process for determining customer satisfaction including frequency of determination and how objectivity and validity are assured. Trends in customer satisfaction and key indicators of customer dissatisfaction shall be documented and supported by objective information.

4.2.9. Quality system for Maintenance

The supplier shall establish, document and maintain a quality system as a means of ensuring that product conforms to specific requirements. The supplier shall prepare maintenance quality covers the requirements of International Standard. This manual shall include maintenance quality system procedures.
**Maintenance quality system procedures**

The supplier shall

- Prepare documented procedures consistent with the requirements of this International Standard and supplier stated quality policy
- Effective implementation of the maintenance quality system and its documented procedures

**4.2.10. Maintenance quality planning**

The supplier shall define and document how the requirements for maintenance quality will be met. Maintenance quality planning shall be consistent with all other requirements of the supplier’s quality system and shall be documented in a format suit the supplier’s method of operation. The supplier shall give consideration to the following activities as appropriate

- The preparation of maintenance quality plans (Control plan)
- The identification and acquisition of any controls, processes and equipment (including inspection and testing equipment).
- Ensuring the compatibility of the design, production process, installation, servicing, inspection and test procedures.
- Identification of measurement requirement
- Identification of suitable verification at appropriate
- Identification and preparation of quality records
- The supplier shall establish and implement an advanced product Maintenance quality planning processes.
• Suppliers should convene internal cross-functional teams should typically include
the supplier's design, manufacturing engineering, quality, production and other
personnel.

4.2.11. Process Failure Mode and Effect Analysis (Process FMEAs)

Process FMEAs shall consider all special characteristics. Efforts shall be taken
to improve the process to achieve defect prevention. Certain customers have FMEAs
and approval requirements shall be met prior to production part approval.

4.2.12. Control plan

The supplier shall develop control plan at the system, subsystem, component
and/or material level as appropriate for the product supplied. The control plans based
on existing plans. New plans required when products or process differ significantly
from those in current production.

Maintenance quality plans are to be living documents and shall be reviewed
and updated as appropriate when any of the following occur.

• The product changed

• The processes are changed

• The process become unstable

• The process become non-capable

4.3. SYSTEM DEVELOPMENT

The various forms of QS 9000 based maintenance quality system have been
developed using HTML and the back end is supported by Java Servlets. The Servlet
program gets the details from HTML page, manipulates the same and presents back
the formatted results again as HTML page. Manipulation are also made with database
for Querying about company details, for this Java Database connectivity (JDBC) concept is made use of.

4.3.1. About HTML

HTML stands for Hyper Text Markup Language, which is an application of Standard Generalized Mark up language (SGML). It is a simple language used to define and describe the layout of a WebPages.

HTML is a rapidly developing mark-up language that forms the basis of documents that are available on the World Wide Web. The main purpose of using HTML is the support of hypertext links between documents and resources available on the Web.

Here with the help of HTML, all the clause comes under ISO 9000 requirements, Sector specific Requirements and customer specific requirements are created.

4.3.2. About Servlets

Servlets are small programs that execute on the server side of a web connection. And, servlets dynamically extend the functionality of the web server. The Java Servlet Development Kit (JSDK) contains the class libraries that will need to create the servlets.

According to Sun Microsystems, a servlet is “a standard approach to extending server functionality without the limitations of server-specific approaches”. A servlet is a Java class and thus needs to be executed by the Java VM, called a servlet engine. Servlets are loaded by the servlet engine, when they are called and remain running until the servlet is explicitly unloaded or the engine is shut down.
4.4. Evaluation Methodology

The design module of KMQS – 9000 consists of questions most suitable for manufacturing enterprises covering all requirements of QS 9000 based maintenance quality system. These questions were framed in such a way that they can design the QS 9000 based maintenance quality system. The questions were grouped under three major sections of QS 9000 based maintenance quality system.

On execution, the user has to enter the name of the company and other details. After that he has to choose any one of the above three requirements, by selecting the appropriate buttons. According to his choice, the corresponding forms will be displayed. For each clause of QS 9000, a form is developed, which will be asking questions to the user. After answering the questions the user has to press the button “SUBMIT” to submit the given details, and also he can change the datas already entered by pressing button “RESET” in a form and pressing the “NEXT” link, another form that contains the next clause will be displayed. The user has to answer the questions by selecting appropriate buttons and writing the necessary procedures and steps that their company will be going to adopt in their organisation. After responding to all the questions, a form will ask the names of the persons by whom it is originated, approved, issue date etc. After responding to this form, another form will be displayed which contains all the elements of QS 9000. He can get the report, by pressing the corresponding button. But before displaying the report, the system will ask the responder by whom it is approved. The responder has to give the name as he entered earlier. Then only the report will be generated. The name of the person by whom it is approved acts like a password to the system. For example, if he presses “Maintenance Quality Policy” button and after entering the query for ‘Approved by’, then a report will be generated which contains, Maintenance quality policy. Likewise, we can
obtain the reports for all the elements of QS 9000. The reports will be generated according to his response to the questions being asked in the forms

4.5. SYSTEM PERFORMANCE

KMQS – 9000 has been developed using HTML and Java servlets for its possibility to publish as a web page in future. As a sample run, details pertaining to all were entered. One such series of screen outputs are shown in Figures 4.1 to 4.13 (given in Annexure A). As soon as the responder enters into KMQS 9000, he has to press the hyperlink in the welcoming page, which in turn switch over to next page, which asks user name and password. On responding to the user name and password the system will start functioning. Then the responder has to answer to all the questions. After entering into the design module, the user has to enter his company details as shown in Figure 4.2. If the company has already consulted this module then system will show an alert reminding him whether he wants to consult the module starting from the beginning or whether he wants to get his previous results. Let us assume ACC is a new user and consulted KMQS 9000 for the first time. After entering company’s details the next screen shown in Figure 4.3 will appear. This screen shows three major sections of KMQS – 9000 requirements. The user can select any of the questions. For every subsection of each section there will be a different screen. The user has to answer to all the queries of the section. Figures 4.4, 4.6 and 4.8 contain ISO 9000 requirements, 4.10 contains customer specific requirements, 4.12 sector specific requirements respectively. At the end of each section the responder is given a choice to exit from the module if he wishes to consult other sections of the module some time later. After successfully responding to all queries of
all sections, a screen, which will contain all the elements of KMQS-9000 will be displayed. The user can get the output in the form of a report by selecting appropriate element. The output reports under the section ISO 9000 requirements are shown in Figures 4.5, 4.7, 4.9, under customer specific requirements in Figure 4.11 and under sector specific requirements in Figure 4.13 are shown. The output of the module will be in the form of reports, work instructions and a detailed quality manual.

4.6. CONCLUSION

This module of the work was carried out with the purpose of investigating the process of attaining the maintenance quality strategy titled as "continuos maintenance quality system".

Two major contributions resulted by conducting this module of work. First, a maintenance quality system model was designed by referring to QS 9000 standard as the basic. Second, the development of the design module of a knowledge base system called KMQS-9000, which would aid in designing the QS 9000 based maintenance quality system. This module would be very useful in identifying the actions to be taken for designing an error free QS 9000 based maintenance quality system. Further usage of this model saves time and expenditure. In fact, that module of KMQS 9000 can be used in various ways. It is recommended that a team of management representatives can sit through the executions (which may take hardly around three hours) of design module of KMQS 9000 to respond to the questions being asked by the system. Alternatively, the management representatives can interact with the design module of KMQS 9000 individually, and the respective outputs can be subjected to approval. In the absence of KMQS 9000 package, this would take very long time.
which would result in delaying the Process of designing QS 9000 based maintenance quality system process from six months to one year.