INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 4, Issue 5)
Available online at: www.ijariit.com

Methods to enhance the efficiency of Quality Management Systems (QMS) in both aerospace and automobile industry

Yashoda Kiran Lingam
kiran.aviation@gmail.com
Himalayan University, Itanagar, Arunachal Pradesh

ABSTRACT

Quality Management Systems (QMS) that incorporate with the Manufacturing Execution Systems (MES) are tactical to any manufacturer's business that provides absolute insight to field use, manufacturing and service information. This information helps to advance the design of the future product and the production optimization which allows faster ramp up in the manufacturing sector. This continuously improves quality and helps the manufacturing processes to diminish waste and decrease per-product costs. Quality Management Systems (QMS) can categorize potential problems before the quality issues occur when incorporated efficiently as part of the closed-loop quality method which proactively monitors events in any enterprise source. Enterprise sources comprise of supplier problems, manufacturing nonconformance, complaints, and services—both globally and locally. The combined capabilities provide risk evaluation, corrective action, and preventative methods, and hence reduce the impact of quality recalls.AS9100 Standard stands out as the first international attempt to devise quality management system standard for the aerospace industry specifically. The standardized systems include Six Sigma, Total Quality Management (TQM) and Continuous Quality Improvement (CQI) is three major systems implemented by major manufacturing companies will be conferred here in this paper.

Keywords— *Quality Management, Aerospace, Automobile, QMS, Quality Tools*

1. INTRODUCTION

In the present era of economic and social globalization, the largest player in the manufacturing world is the automotive industry. There is great competition in the automotive industry. For stable economic growth, low-cost manpower, low-cost production, and high production, the organization needs to produce and deliver innovative, improved and efficient products. In this way, only one company can survive the competition. Thus, it forces the organization to uphold high-quality products under the enormous competitive pressure (Kohli & Singh, 2015) The cars designed in a country can be mounted in another. The products or parts supplied may come from different sources that may have been shared from the fourth and so on. In this way, a large chain of organizations plays an important role in the manufacture of a car. Management is characterized by its global and overall strategy. It is the organizational strategy and management methodology that allows members of an organization to contribute in the basic purpose of constantly improving efficiency and functionality. The car's quality management system is based on the ISO / TS standard, which mainly focuses on processes(Goicoechea & Fenollera, 2012), and to customer satisfaction (intermediate or final) in which both suppliers and employees are involved is mentioned in figure 1. In 1987, the International Standards Organization (ISO) published ISO 9000 standard quality management system.

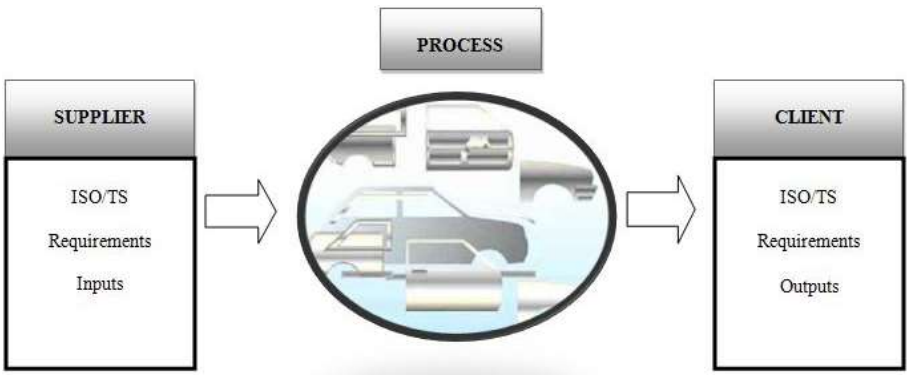

Fig. 1: Manufacturing process

ISO 9000 helped to define many of the elements in audio quality practices, but it did not guarantee the suitability of the use of the product, as it only concerns coherence in the process. Attempts were made to change the ISO 9001 for the automotive industry, but since the necessary changes were not relevant to companies outside the automotive industry, a new ISO TS16949 standard was established in 1999 (Liu, 2009). The International Standard ISO / TS 16949 specify the crucial requirements for the implementation of ISO 9001: 2000 in the manufacture of cars.

The major reason for the success of the Aerospace industry depends on the ability of the organization to provide high-quality services and products who constantly meet the expectations of the customer. Aerospace Quality Management System Standards are specific to provide the industry standards (Lazur, Jagadeesh, Karthikeyan, & Shanmugaraja, 2013).

- Internationally accepted frameworks for the best practices
- Addressing the distinctive needs of repair operations, manufacturers, distributors, and maintenance.
- Providing many benefits to the companies who adopt the standards' necessities.

Types of aerospace quality management system standards:

- **AS 9100** is important, in which the defense, air conditioner, product conformity, and reliability are confined. These standards are important for OEMs in spacecraft production, maintaining high levels of responsibility for their productivity.
- **AS10 9110** concentrates on repair and maintenance programs, skills and qualifications required to perform MRO tasks in the planning, maintenance management, and space community.
- **AS91 9120** was created for the distributors of aerospace products. This standard cache is addressed for traceability, control, custody, and availability of records.

2. QUALITY MANAGEMENT SYSTEM

Quality management is a set of business processes, policies, and processes that collect ideas from, systems analysis, statistics, operational research, technology, problem-solving, management science, group dynamics, human genetics and organizational development focusing on the quality policy and goals to meet the needs of the customer. QM is basically a philosophy which comprises of the principles, practices, and tools (Dean Jr & Bowen, 1994) which includes principles or values like customer focus, fact-based decisions, and continuous improvement (Hellsten & Klefsjö, 2000).

Six Sigma methods are used to identify and control variables that affect the output of the process. Thus, six sigma collects concepts and techniques of statistics and administration which is aimed at reducing the variation in the process and preventing defects in the product (Arunagiri & Babu, 2013). There are three main dimensions for measuring process quality: efficiency, efficiency, and adaptability. The process is completely effective if the product meets the needs of the customer. It is effective at the lowest cost. The process is adaptable when it is highly efficient even in case of the many changes that take place over the period of time. An organized QMS process the steps for important processes and creates methods to prevent errors in time. QMS is organized to protect the brand, organizational processes, and customer interests. A diagram on the continuous improvement of QMS is depicted in figure 2.

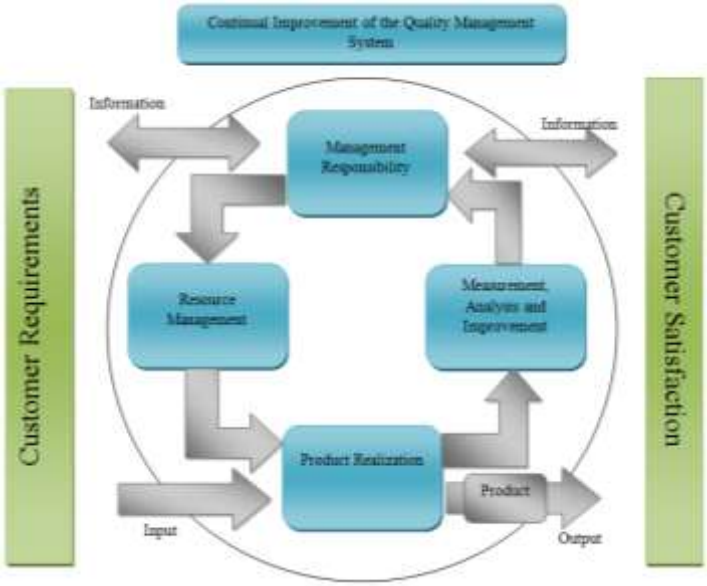

Fig. 2: Continual improvement of the Quality Management Systems

2.1 Benefits of implementing QMS

- Achieve organizational objectives.
- Manage growth more effectively.
- Correct problems to improve products and services.
- Increase market share in new domains and market sectors.
- Creates high-quality culture
- Delivery of Consistent products.
- Measure the performance of individuals and teams.
- Reduce major errors which can create a huge loss.

2.2. Steps to implement an effective QMS

1. Define and map the processes
2. Define the quality policy
3. Define quality goals

Some critical success factors are:

- Product Quality
- Customer satisfaction
- Market share
- Financial results
- Process improvements

2.3. Develop measurement values to track and monitor CSF data
2.4. Define defects for each process
2.5. Develop records and documents
2.6. Identify quality process
2.7. Resolve training needs

Some important areas of training are Internal Audit Competency, Failure Modes Effects Analysis (FMEA) education, Action Training.

2.8. USE QUALITY MANAGEMENT SYSTEM

QMS refers to generate the best quality product. The process includes

- Collect deviation in the process and record them.
- Review these corrective and preventive data.
- Review FMEAs for risks and actions, if necessary.
- Perform internal audits and conduct the management reviews.

2.9 Measure, monitor and implement activities to improve the performance

The following points are included here for the process:

- Tracking quality goals and performance
- Define some new performance goals
- Determine data recovery capabilities by recognizing trends, patterns or correlations.

3. REVIEW OF LITERATURE

This work highlights the tools and techniques that Indian Industries uses for the quality management approach to meet global standards. The document deals with the similarity in the implementation of processes such as Employee Empowerment, Product Design, PDSA, Six Sigma, etc. TQM is the management process and a set of rules to ensure that the organization meets the customer's requirements. It is a combination of management tools and quality. The ISO TS 16949 certification is granted to companies that emphasize process-oriented quality management systems, resulting in defect prevention, variation limitation and waste elimination in techniques and tools for quality control of the supply chain: Kaizen refers to the continuous improvement of all activities which enable employees to gain incentives and resolve the problems. The design of the product is the transformation of ideas into a new product. Six Sigma is the statistical technique for the process improvement. PDSA stands for Plan-Do-Study-Act Cycle. There are several emerging quality control tools. Image Analyzer is the production tool that ensures the design, safety, and comfort of the vehicle. Computer Numerical Control is the automation process where different functions of the machines are controlled by numbers, letters, etc. All observed companies have noticed ISO 16949 TS and OHS 18001Certificates. More than 90% of companies use tools such as Kaizen, Employee Empowerment, Six Sigma, etc. (Kohli & Singh, 2015).

In this research work, TQM is being emphasized. TQM is the set of management processes and rules that ensure that the organization meets and exceeds the customer's needs. TQM companies focus on systematic data management. Almost the entire automotive industry has reduced costs, increased the efficiency of the process and improved the quality of its products and services. TQM is a process where management and employees can be involved in the continuous improvement of the production of goods and services. The concept of TQM philosophy is customer focus and continuous improvement. The quality must meet and exceed customer expectations. TQM is about continuous improvement of work, strategic planning and decision making with detailed implementation. In TQM, workers have the power to make decisions about quality in the production process. Workers must know how to assess quality by using a variety of quality tools. Here the efficient tools translate the client's voice into specific technical requirements for the implementation of the quality function. TQM extends the concept of quality to suppliers of a company (Isac, 2010).

This research study studies the various quality tools followed by the Indian automotive industry to achieve Total Quality Management. The work focuses mainly on 23 key quality tools. The implementation of these tools in the automotive industry in India is broadly discussed. TQM focuses mainly on customer satisfaction. Japan's automotive industry adopted these principles and became a leader in the market. The research is done by a questionnaire to investigate 23 key TQM tools. 62% of the industry follows TQM as an indicative principle. 79% of the automotive industry claims that they have obtained the ISO 9000 / QS 9000 / ISO 14001 certification. The most popular quality tools are Operation Diagram and Pareto Diagram. The least understood tool is Six Sigma. In the automotive industry much has to be done about the implementation of quality tools like 5S, Kaizen, TPM, BPR, PERT.CPM, QFD, and Six Sigma (Khanna, Vrat, Shankar, & Sahay, 2006).

Diverse automotive industries are in various phases of quality movement. The document is studying the association between industry in Thailand and Malaysia. A theoretical model that uses modelling of structural equations has been proposed. It has been perceived that quality is the most significant factor to survive in a global industry. It is also a vital measure of the industry's economic success. Quality management designs are also investigated, such as quality management, emphasis, and customer satisfaction quality analysis and information etc. Quality management practices enhance the performance of the organization (Zakuan, Yusof, Laosirihongthong, & Shaharoun, 2010)

4. THREE MAJOR TECHNIQUES ADOPTED BY MAJOR COMPANIES

4.1 Total Quality Management (TQM)

TQM is a management process where quality is emphasized in all aspects of the business and organization. Its goal is to focus on long-term development of quality services and products. TQM breaks down every activity or process and accentuates that each contributes or degrades the organization's productivity and qualityon the whole. The management part in TQM is to progress quality strategy which is springy enough to adapt to each department, in line with organizational business goals and based on customer and stakeholder needs. When the strategy is defined, it must be the motivational power to be distributed and communicated to be effective at all levels of the organization. A certain degree of human resources is also included in the TQM strategy and usually involves both departmental and cross-functional groups to develop strategies to solve quality problems and propose improvements. TQM principles can satisfactorily take a company's processes under statistical control and it can define a sustainable infrastructure for implementation. The TQM tool has been considered a successful system that can achieve significant gains in business development. Apart from the strength in which it focuses on quality and the ability to more satisfactorily take a business process under statistical analysis, many TQM tools consider a business strategy while others refer to it as a well-structured and highly effective method that achieves product and process variation improvements which in turn increases operational performance. Companies like General Electric and Motorola have implemented this TQM approach to great success and have built their own business process improvement.

4.2 Continuous Quality Improvement (CQI)

The continuous quality improvement was created in the industry as another approach to quality and quality systems. It does not focus so much on creating a quality culture for businesses, but more on the quality improvement process by using groups or groups that are rewarded when goals and quality levels are achieved. CQI enables individuals involved in the daily business to change and improve processes and workflows at their discretion. It strives for continuous innovation to improve work processes and systems by reducing time-consuming activities with low added value. The savings on resources and time is spent on planning and coordination. CQI has been adopted in various industries. The acronym FOCUS-PDCA work describes.

- Find a process to improve.
- Organize to improve a process.
- Clarify what is known.
- Understand variation.
- Select a process improvement.

Then move through the process improvement plan:

- Plan—create a time line, including all resources, activities, dates, and personnel training.
- Do—implement the plan and collect data.
- Check—analyze the results of the plan.
- Act—act on what was learned and determine the next steps.

The FOCUS PDCA acronym is a simple management system for communicating teams, helping them stay organized and track the end result in mind. The system has proven to be very successful for the CQI team.

5. SIX SIGMA

Six Sigma was developed by Motorola in the 1980s as a method to measure and improve large-scale production processes. The overall goal was to measure and eliminate waste by trying to achieve near perfect results. The term six sigma refers to a statistical measurement with not more than 3.4 defects per million. Numerous companies, including General Electric, Ford and DaimlerChrysler, have credited six sigma for enabling themsaving huge dollars. Six Sigma is a statistically oriented approach to process improvement using a variety of tools, including statistical process **control** (SPC), total quality management (TQM) and design of experiments (DOE). It can be coordinated with other important initiatives and systems, such as the development of new products, material requirements planning (MRP) and just-in-time (JIT) inventory management. Six Sigma was considered as a system that which is utilized only for production operations, but more recently it has also proved successful in non-manufacturing processes, such as creditors, invoicing, and marketing Six sigma seemed to be structured in analyzing the processes which are not up to the standard in case of production situations, but the six sigma theory is flexible enough to be suitable for each and every process.

Below is a brief description of the steps that are part of the six sigma process:

1. Break the business process flow into any individual steps.
2. Defining the errors
3. Measure the number of errors.
4. Inquire for the root cause.
5. Make changes to improve.
6. Premeasured.
7. Take a lasting view of the goals.

6. CLASSIFICATION OF QUALITY TOOLS

This report focuses on the most used tools in the sector and on those forced to be used by the manufacturer as a general rule:

1. PDCA cycle or Deming
2. Q7: the seven basic tools of quality
3. M7: the new seven tools
4. Control techniques
5. Planning techniques
6. Improvement techniques

Table 1: PDCA cycle or Deming, Q7: the seven basic tools of quality, M7: the new seven tools

S. No.	Title	Tool/Techniques	Description
1.	**PDCA cycle or deming**	•PLAN •DO •CHECK •ACT	– Assortment of problems and planning of improvement actions. – Realization of concrete actions to solve the problem – Validations of the results and controlling of aims – Improvement of actions, of the situation, etc.
2.	**Seven basic tools of quality**	•Check sheet •Flow charts •Cause- and Effect diagrams (fishbones) •Control charts •Histogram •Pareto charts •Scatter plot	They are known by "The Seven Basic Statistical tools" because they are appropriate for people with little formal education in statistics
3.	**M7: The new seven tools**	•Affinity diagram •Relations diagram •Tree diagram •Matrix data analysis matrix diagram •Process Decision Program Chart (PDPC) •Arrow diagram	This is an assortment of useful tools for decision-taking at management level. Their popularity has increased in the engineering and manufacturing fields over the last twenty years.

7. CONTROL TECHNIQUES

a) SPC (Statistical Process Control)

- Capacity studies provide indicators called capacity index (Cp, Cpk, Pp, Ppk), which informs about the level of compliance.
- Process stability should be guaranteed to handle them if they are not in control.
- Control Schemes represent the Statistical Process Control (SPC) tool and announce when a process stops following the random pattern of normal behavior.

b) Definition of indicators

Key Performance Indicators are quantifiable aspects that reflect the critical factors. There are many important indicators related to quality

c) Audits

There are many types of audits, classified internally or made by the customer. Used in car companies, where there are several auditors who plan annual audits of various types: Production, Run on Rate; Pre-production (Internal).

8. PLANNING TECHNIQUES

a) FMEA (Failure Mode and Effects Analysis)

It is a mandatory tool in the automotive industry to be aware of the various faults that can occur at any time; the aim is to take into account three aspects: severity of the failure, failure or probability of occurrence, and error detection or identification possibility during the process.

b) Benchmarking

It is a systematic, continuous measurement and comparison process to determine the "best" methods to improve the performance of an organization.

c) DOE (Design of Experiments)

This method is used for process optimization. Implementation of infers to reduce the number of tests and product development are organized more economically.

d) QFD (Quality Function Deployment)

The core of this approach is referred to as the House of Quality. This technique categorizes customer requirements and delivers a discipline to guarantee that those requirements are encompassed in the product design and in the development process. It diminishes the product development cycles reduces costs and surge quality.

This tool requires each and every customer requirements specifications intents needs and expectations to be understood and properly communicated to the production and operations departments through engineering controls and documentations.

9. IMPROVEMENT TECHNIQUES

Table 2: Improvement techniques

	8D Tool (8 Disciplines)	8D Tool (8 Disciplines)
Improvement Techniques	Poka Yoke	Improvement groups as team working method for problem- solving and reduces human errors. This is most widely used technique
	TPM	Total productive management
	Lean Six Sigma	Methodology that firms can use to improve the output quality of a process

10. EMERGING TECHNIQUES OF QUALITY CONTROL IN AUTOMOBILE INDUSTRY

QM can be incorporated with EM and it affects the firm performance (Molina-Azorín, Tarí, Claver-Cortés, & López-Gamero, 2009); Lean management is connected to supply chain management and sustainability(Martínez-Jurado & Moyano-Fuentes, 2014); or quality (ISO 9001) and environmental (ISO 14001) management systems (Heras-Saizarbitoria & Boiral, 2013).

Recent techniques of quality control are being utilized in the Automobile industry. This includes Laser marking, computer numerical control; contour measuring, image analyzer, satisfaction index, and Autophoretic painting. Image Analyzer is a production tool generally utilized in automobile industry which ensures safety, required design, comfort and the aesthetic appearance of evident parts of an automobile. It assists in reducing the deviations from the required geometry of product. Laser marketing is the production quality technique which is widely utilized in the automobile sector. The laser-marked code comprises of the date of manufacturing, serial and lot of numbers and other information too. The vision system, laser, handling system, and software are incorporated into the production line to boost efficiency. The contour measuring aid in attaining the shape of auto ancillary parts based on two dimensions- macrostructure (position and dimension) and microstructure (waviness and roughness). Contour measuring systems are intended in modules for the assigned tasks. Single Minute Exchange of Die Technique is the lean production technique aimed at reducing the waste in the manufacturing process. The phrase "single minute refers that it should take less than 10 minutes to start up the next process.

Computer Numerical Control (CNC) Technique is an automation process wherein the machines are reigned by number, letters, and symbols. Here for CNC technique, machine operation relies on the program which is fed into it. Autophoretic Painting is the method of auto deposition and is the best substitute for traditional electronic coating. Satisfaction Index is one great technique for attaining customer Feedback. Here in this technique, many categories related to customer satisfaction are being measured and the reported items are designed as per 1000 orders to calculate the percentage of customer satisfaction.

11. CONCLUSION

The need for the quality management system in the automotive sector has improved enormously. Every organization must have a quality assurance system to maintain the quality in the future. OEMs should maintain the quality of their end products. It is essential for this standardization for QMS between OEMs and their suppliers. ISO TS16949 plays a crucial role in here wherein all organizations have to be certified here. To implement ISO TS16949, an organization must adopt, adapt and modify many aspects, regulations, and standards. The implementation of ISO TS16949 not only standardizes QMS but also enhance the quality of products between OEMs and suppliers. All organizations in the automotive sector should ensure that defects are neither manufactured nor shipped. Therefore quality plays a major role in the production process. To achieve this, an organization must therefore also have its own internal quality management system with the standardized QMS. ISO / TS 16949 offer significant benefits for an organization. But if a company has its own internal QMS together with ISO / TS 16949, it can offer better quality with minimal costs. Aerospace industries should also ensure its quality standards for better efficiency. Here most of the research is being done at a conceptual level for both automobile and aeronautical sector, highlighting the ideas of synergies. However, few articles hold the potential affirmed by empirical evidence(Siva et al., 2016).

12. REFERENCES

[1] Arunagiri, P., & Babu, G. (2013). Review on Reduction of Delay in the manufacturing process using Lean six sigma (LSS) systems. *International Journal of Scientific and Research Publications*, *3*(2), 1-5.
[2] Dean Jr, J. W., & Bowen, D. E. (1994). Management theory and total quality: improving research and practice through theory development. *Academy of management review*, *19*(3), 392-418.
[3] Goicoechea, I., & Fenollera, M. (2012). Quality management in the automotive industry. *DAAAM International Scientific Book*, 619-632.
[4] Hellsten, U., & Klefsjö, B. (2000). TQM as a management system consisting of values, techniques, and tools. *The TQM magazine*, *12*(4), 238-244.
[5] Heras-Saizarbitoria, I., & Boiral, O. (2013). ISO 9001 and ISO 14001: towards a research agenda on management system standards. *International Journal of Management Reviews*, *15*(1), 47-65.
[6] Isac, N. (2010). Principles of TQM in the automotive industry. *Romanian Economic and Business Review*, *5*(4), 187.
[7] Khanna, V., Vrat, P., Shankar, R., & Sahay, B. (2006). Usage of Quality Tools in the Indian Automobile Sector. *Journal of Management Research (09725814)*, *6*(3).

[8] Kohli, A., & Singh, R. (2015). AN EMPIRICAL STUDY OF VARIATIONS IN CRITICAL SUCCESS FACTORS OF QUALITY MANAGEMENT PRACTICES IN INDIAN MANUFACTURING INDUSTRY. *Integral Review: A Journal of Management*, *8*(2).
[9] Lazur, B. I., Jagadeesh, L., Karthikeyan, B., & Shanmugaraja, M. (2013). An initiative to practice total quality management in aircraft maintenance. *Advances in Aerospace Science and Applications*, *3*(2), 63-68.
[10] Liu, C.-H. (2009). Effect of ISO/TS 16949 on Six Sigma: The empirical case of Taiwanese automobile and related industries. *Total Quality Management*, *20*(11), 1229-1245.
[11] Martínez-Jurado, P. J., & Moyano-Fuentes, J. (2014). Lean management, supply chain management and sustainability: a literature review. *Journal of Cleaner Production*, *85*, 134-150.
[12] Molina-Azorín, J. F., Tarí, J. J., Claver-Cortés, E., & López-Gamero, M. D. (2009). Quality management, environmental management and firm performance: a review of empirical studies and issues of integration. *International Journal of Management Reviews*, *11*(2), 197-222.
[13] Siva, V., Gremyr, I., Bergquist, B., Garvare, R., Zobel, T., & Isaksson, R. (2016). The support of Quality Management for sustainable development: a literature review. *Journal of Cleaner Production*, *138*, 148-157.
[14] Zakuan, N., Yusof, S. M., Laosirihongthong, T., & Shaharoun, A. M. (2010). Proposed relationship between TQM and organisational performance using structured equation modelling. *Total Quality Management*, *21*(2), 185-203.

