Trends in Teaching Supplier Quality Assurance in the Global Automotive Industry

Farouk G. Attia, Jignesh Rathod
University of Houston, Houston, Texas 77204-4021

Abstract

Automotive manufacturers worldwide utilize global purchasing strategies to shorten the time to market their products and reduce the costs due to international competition as well as abiding by stricter product liability laws and greater customer expectations. Global suppliers have to provide similar components to different automotive manufacturers worldwide, in accordance with their individual quality assurance systems requirements. The existence of multiple quality systems for such suppliers may cause lesser flexibility, more costs and delays in shipments, greater lead times, etc., all of which are sources for reduced efficiency of the quality system standards.

Similar to the concepts outlined in the ISO 9000 family of Quality Assurance Systems, the automotive manufacturers worldwide through an international task force have formulated a unified quality management specification ISO/TS 16949: 2002, for their suppliers, based on the guidelines of ISO 9001 systems. Before developing this unified specification, each of the manufacturers had their individual quality management specification for the suppliers to comply with and get registered in, such as QS 9000, VDA 6.1, EAQF, AVSQ etc. The new unified specification has incorporated the major similarities of the multiple quality specification systems, along with other customer specific requirements, eliminating the need for multiple registrations, audits and documentations. The benefits of this step are tremendous in terms of cost savings, better management and control of the specification and also for the supplier registration process with a new approach to quality management.

This paper presents an overview of supplier's Quality Assurance Systems in the global automotive industry and a comparative study of some of these systems from a supplier's quality management perspective, with an emphasis on the design and formulation of the quality management specification ISO/TS 16949.

Introduction

Growth in international trade has provided today's customers with lots of choices. The International status of customers has put pressure on suppliers to comply with multitude of quality standards, each specific to a certain industry, trading organizations or group of countries. This multiplicity of quality systems has burdened the suppliers with huge amount of paper work, unnecessary or repeated inspections, loss of productive time and focus from product quality, not to mention the costs of various audits and registrations to each of the quality systems[1]. At the same time, the traditional quality control methods based on inspections are becoming obsolete, unreliable and costly, as product life cycles

have shortened and modern manufacturing processes are adopted to respond quickly to the changing tastes of customers.

The ISO 9000 series standards attempted to unify the salient features of quality systems of various trading organizations and countries. However, the guidelines provided therein are very generic and applicable to any industry where quality system is desired. Also, compliance with ISO 9000 standards did not guarantee that a manufacturer always produced a quality product, but ensured that the manufacturer had a quality system in place according to one of the four published quality systems to produce products or services consistent with customer's requirements[2].

The requirements of automobile manufacturers (OEMs) on the other hand, from the supplier's quality systems are very stringent and though similar, are not the same as ISO 9000 standards. Also, by the time ISO 9000 series were published, most of the automotive manufacturers had their own quality system in place internally and externally, i.e. within their own organizations and with their suppliers. For example, the American "big three", namely, Chrysler (now Daimler Chrysler), Ford and General Motors (GM), had their own individualized sets of supplier quality systems and corresponding assessment documents, *Supplier Quality Assurance Manual*, *Q-101 Quality System Standard*, and *NAO Targets for Excellence* respectively. While in Europe, suppliers had three major sets of standards, namely, EAQF (French), VDA 6.1(German) and AVSQ (Italian).

The American OEMs harmonized their QMS requirements under *Quality Systems Requirements: QS 9000* in August 1994 through the efforts of the Supplier Quality Requirements Task Force. This task force included participating members from the big three American automotive manufacturers, representatives from major truck manufacturers like Mack Trucks, Navistar International, Peterbilt Trucks, Volvo GM, Kenworth Trucks and Freightliner Corporation, and the automotive division of the American Society of Quality (ASQ). In September 1994, QS 9000 officially replaced all previously existing multiple quality system manuals and programs and was also simultaneously adopted by the truck manufacturers as their supplier quality system program. QS 9000 requirements applied to all internal and external suppliers of raw materials, components, subassemblies and service parts.

Characteristics of the QS 9000 Specifications

The underlying principles for QS 9000 come from ISO 9001: 1994 standard. QS 9000 is structured into three sections. Section 1, *Core Requirements*, consists of twenty elements, reproduced verbatim, in Italics, from ISO 9001: 1994 Section 4. Additional comments, modifications or interpretations to these elements, to fit the automotive industry, are presented in regular font. Section 2, *Sector Specific Requirements*, covers the *Production Part Approval Process*, *Continuous Improvement*, and *Manufacturing Capabilities*, which are beyond the scope of any ISO 9000 standards but are automotive industry specific. Section 3, *Customer Specific Requirements*, includes four subsections, each

covering the specific quality requirements of Chrysler, Ford, GM and the truck manufacturers respectively from their suppliers[2]. Suppliers who do not design their own products can use ISO 9002 instead of ISO 9001 as core requirements under Section 1. Similarly, for suppliers who only provide testing and inspection services they can use ISO 9003 under Section 1, as the core requirements[1].

Besides QS 9000, there are four reference manuals developed by the big three as supplements to QS 9000, which provide specific techniques and methodologies for suppliers to follow regarding QS 9000 requirements[3].

- Advanced Product Quality Planning and Control Plan (APQP)
- Failure Mode and Effect Analysis (FMEA)
- Statistical Process Control (SPC)
- Measurement System Analysis (MSA)

Companies supplying to European based automotive OEMs like Volkswagen, Audi, Mercedes-Benz, BMW, Porsche, Opel etc., had to meet the quality system requirements specific to the European Automotive Manufacturers[4] like the French EAQF or the more widely known German VDA 6.1, promoted by Verband der Automobilindustrie (VDA), the trade organization of the German auto industry. VDA was first issued in 1991 and became mandatory for all German car manufacturers and suppliers starting April 1999, after its fourth edition release in 1998[5].

VDA 6.1 consists of two essential parts: 1) management responsibilities and business strategy, and 2) product and process requirements. The management section contains 6 elements from the ISO 9001: 1994 section 4 plus Z1 and discusses issues related to internal quality audits, training and personnel, product safety, corporate strategy and employee satisfaction. The product and process section contains the remaining 14 elements of ISO 9001: 1994 section 4 plus two new elements related to design control, process planning, purchasing, process control, corrective and preventive action, control of quality records and statistical techniques[3].

Development of ISO/TS 16949 Specifications

The efforts behind the development of ISO/TS 16949 were lead by the European automotive OEMs and suppliers to reduce the multiplicity of automotive quality system standards that existed in Europe due to the French, Italian, German and British standards. Also, cross-continental buyouts like the purchase of Daimler by Chrysler created new problems for suppliers dealing with American and European OEMs, having to deal with the multiplicity of quality systems. As consolidation in the Automobile industry increased, more and more suppliers were facing the multiplicity problems.

Meanwhile, it was felt by the developers of QS 9000 that the standard was reaching the end of its lifecycle as it lagged behind the contemporary management processes and focused on product quality rather than the process capability. Many problem suppliers

were able to acquire QS 9000 certification and bureaucracy had crept in making the changes and further development in the standard difficult. Suppliers were less enthusiastic in registering for multiple systems. The OEMs on the other hand, had no more plans to update QS 9000 to meet the new requirements of ISO 9001: 2000 and agreed to phase out QS 9000 by 15th December 2003[6].

The automotive OEMs and national trade associations formed an International Automotive Task Force (IATF) to bring together the requirements from the existing quality system standards, to create one global automotive quality standard. The OEMs were the American big three, European manufacturers like Fiat, Renault, Peugeot, BMW and Volkswagen, and the national trade associations included AIAG (America), VDA (Germany), SMMT (UK), ANFIA (Italy), and FIEV (France). In conjunction with the ISO/TC 176, the IATF wrote the draft of an international automotive standard, ISO/TS 16949 in 1999, based on the format of ISO 9001: 1994. With the publication of ISO 9001: 2000 edition, ISO/TS 16949 was re-written to incorporate changes and bring it in line with the guidelines of ISO 9001: 2000, and formally issued in March 2002 as ISO/TS 16949: 2002[7], here after called ISO/TS-2.

Main Features of the Specification

ISO/TS-2 specifies the quality system requirements for the design, development, production, installation and servicing of automotive related products. It encourages the application of standard to understand the inter-relationship of processes within the organization to improve product or service quality. Since the standard is based on ISO 9001: 2000, the guidelines are very generic and suppliers have to subscribe to the company specific requirements in order to reduce multiple registrations. ISO/TS-2 is considered equivalent to QS 9000, VDA 6.1 and other European standards only when the suppliers comply to company specific requirements also. Together, the quality system eliminates the need for multiple certifications. OEMs including Ford, Daimler Chrysler, GM, Peugeot, Fiat, BMW, and VW have formally published their company specific requirements and accept ISO/TS 16949 registrations, though the American OEMs do not mandate such a registration till 15th December 2006[8].

The new ISO/TS-2 standard is more demanding than its predecessor ISO/TS 16949: 1999 and the QS 9000 standard, which were largely based on ISO 9001: 1994 series standard. The whole emphasis in the new standard, as also the ISO 9001: 2002 upon which it is based, has shifted from individual functions, described by the twenty elements of previous versions of both ISO 9001 and ISO/TS 16949, to five major interrelated processes in an organization.

The process model is based on the idea that an organization is a system of interlinked processes. The ISO 9001: 2000 standard is designed to manage and improve those processes[9].

- Identify the key processes of the organization.
- Define quality standards for those processes.
- Decide how process quality will be measured.
- Document the organization's approach to achieving the desired quality, as determined by the measurements in step four.
- Evaluate the measured quality of the process and continuously improve upon it.

The process orientation of the new standards provide opportunities for systematic evaluation of current processes using flow charts and the participation of cross departmental teams to flowchart the process. Once a valid flowchart of the process is available, the cross departmental team can improve or simplify the processes, sometimes with dramatic results. The improved or modified flowchart is then measured against the requirements of ISO/TS 16949 and continually improved upon[10].

New Aspects of ISO/TS-2

Major changes are seen in the new ISO/TS-2 standard. The classification of the elements has been reconfigured and now grouped into five units namely, Quality Management System – Section 4, Management Responsibility – Section 5, Resource Management – Section 6, Product Realization – Section 7, and Measurement, Analysis and Improvement – Section 8. This configuration is in line with its foundation document, the ISO 9001: 2000 standard.

Supplier's attention is focused on continuous improvement of quality. Suppliers are expected to establish goals, objectives and measurements to develop their quality policy and this quality policy should cover continuous improvements in quality, service, costs, and technology. By use of the word "shall", the standard mandates that all the production shifts be staffed with personnel responsible for quality and that he or she shall have the authority to stop production in case of quality system failure. Evaluation of cost of poor quality is a specific requirement in the new standard but was mentioned as a parenthetical note in QS 9000. As a continuous improvement process, management review now includes the review of the performance of the quality system over time. Suppliers must develop a method for motivating its employees to achieve quality objectives and providing quality awareness. Employee satisfaction and moral must be measured by use of documented procedures. Product safety considerations from QS 9000 have been expanded to minimize risks and exposures to employees, customers, users and the environment[11].

Newer additions are found with the introduction of the term "product realization" covering the entire process of designing, planning and delivering products that meet customer requirements. A project management approach to quality planning is suggested and the factors required to measure the progress of the planning process are identified as quality risks, costs, lead times, and critical paths. Process capability must be measured on all new processes. Documented procedures for the management of the product realization processes are mandated through identification of process design inputs, validation of

input against process design outputs, process design output documentation, process verification and documentation of results of verification.

The requirement for skill qualification for the personnel on the supplier's design team has become mandatory (use of "shall") and suppliers are expected to have access to research and development to support product innovation. Moreover, suppliers must now consider the impact of changing product designs on customer's assembly operation.

The terms "process monitoring" and "process instructions" has been replaced with "job instructions" for simplicity and clear understanding. The job instructions are required to be ("shall" be) present at the job location without disruption to the progress of the job. These job instructions are derived from "appropriate sources" including the control plan and the entire product realization process. Significant process events such as tool change or repairs to the equipment shall be documented and retained as quality records. Laboratory requirements, both internal and external, must now comply with ISO/IEC 17025.

The supplier is required to notify the customer in case of delay in delivery schedule and must implement corrective actions in order to prevent any more occurrences. Supplier must now use the same controls for handling nonconforming and obsolete products and the production system should have built-in ability to track the progress of a customer's order in process.

As per ISO/TS-2, all shifts are subject to audits. However, ISO/TS-2 does not allow splitting of audits while QS 9000 does. Furthermore, the internal quality audit in the new standard now includes all specified requirements at appropriate stages of the production and delivery process. Process audits are covered under new subheading and suppliers have to show audit plans and results for System, Process and Product audits. Internal audit must include the evaluation of the effectiveness of the product realization process and production process. A more important requirement under this element is the internal auditor qualification, which must comply with customer's criteria.

Benefits of one International Standard

1. ISO/TS-2 encourages a process approach to quality management and commits the top management to quality management. Emphasis is on continuous improvement of organizational processes with a focus on customer's requirements.

2. The new standard eliminates the need for multiple registrations to multiple quality systems by incorporating contractual requirements of not only the American auto industry but also that of the German, French and Italian auto industries. Quality system maintenance costs like audits, surveillance, compliance to technical specifications etc. are greatly reduced and suppliers can concentrate on improving performance with respect to one globally accepted quality system. Allows better use of supplier resources.

3. The technical specifications help in conducting business world wide as they are recognized internationally. On the other hand, an ISO/TS-2 certification with a manufacturer means greater confidence in global sourcing. ISO/TS 16949 enhances the potential for strategic partnering

4. The use of ISO/TS-2 allows a common Quality Management System approach throughout the automotive industry supply chain and aligns the Quality Systems of the entire global supply chain to ISO 9001: 2000.

5. OEMs can execute better control of the registration and assessor training processes and less bureaucracy is expected at all levels.

6. Concepts of existing business improvement methodologies like Failure Mode and Effect Analysis (FMEA), Statistical Process Control (SPC), Six Sigma etc. are incorporated in the standard enabling a unified approach to business improvement[12].

7. It supports team approach to quality planning and management.

Supplier Eligibility Criteria and Certification

IATF is responsible for developing the certification scheme, auditor qualification requirements, common registration rules, certification body contracts and supplier third party certification schemes. It has developed its own unique and proprietary registration process and supplier registration requirements in order to ensure global consistency with the ISO/TS 16949 registration scheme. The IATF also prescribes certain supplier eligibility criteria for the ISO/TS-2 certification. Some of the criteria are enlisted below:

1. The technical specification is relevant to automotive production and service part organizations only. This implies that vehicles manufacturing plants, assembly plants, and parts manufacturing and assembly plants, supplying to an automobile manufacturer or assembler, are all eligible for a certification. The certification is not valid for after sales service or stockists, dealers or distributors.

2. Only automotive product manufacturing lines are eligible for certification under ISO/TS-2. Meaning, if an organization has automotive and non-automotive product lines, they will require separate certification for the two product lines. ISO/TS 16949 will cover the automotive product line only.

3. Any tier within the automotive supply chain can apply as long as an actual value adding activity takes place.

4. Organization in non-automotive product business can apply for certification only if they have a documented request for quotation or is on a customer's potential supplier's list.

The implementation and operations management of the ISO/TS-2 registration schemes lies with the five regional offices of the IATF. The oversight bodies provide common procedures for auditor qualification training and exam, audit witness, monitoring the certification bodies and auditor performance, implementation of IATF policies and decisions, maintaining a central database to assist in the management of the registration schemes, and support the IATF in its pursuit of applying a harmonized global automotive QMS. IATF oversight offices issue accreditations to certification bodies like TUV, AQA, BVQI, DNV, BSI, etc. for supplier third party certification and registration[7].

The members of the Supplier Quality Requirements Task Force have no intentions of revising the QS 9000 standards to align it with the ISO 9001: 2000 standard. From December 15th 2003, ISO 9001: 1994 becomes obsolete and QS 9000 will no longer be supported by ISO 9001: 1994. The members of the task force have formally announced that QS 9000 will remain in effect until December 14th 2006 by which time the suppliers have to upgrade their certification to ISO/TS-2. Automotive OEMs, depending on their company policies, can ask for supplier compliance, upgrade or mandatory registration with ISO/TS-2 standard.

Conclusions

The ISO/TS 16949 specifications are developed by the global automotive industry to achieve uniformity and consistency in the Quality Management Systems within the organization as well as in the global supply chain of automotive industry. The specification is in lines with the latest guidelines prescribed by the ISO 9001 standards and together with the customer specific requirements, are intended to achieve world class product quality, productivity, competitiveness and continual improvement through a process approach to implementing quality management systems.

Vehicle manufacturers are either mandating the ISO/TS-2 registration or encouraging the suppliers to upgrade their QMS to the new specifications. The older QMS specifications currently in use such as: QS 9000, VDA 6.1, EAQF, AVSQ and ISO/TS 16949: 1999 are becoming obsolete and the automotive manufacturers have no plans to upgrade the old specifications. The US and the European automobile manufacturers accept ISO/TS-2, along with the customer specific requirements, as equivalent to all the older specifications. Certification or compliance to ISO/TS-2 will eliminate the requirements of multiple certifications by the suppliers.

ISO/TS-2 is an opportunity for organizations to build or upgrade their QMS that is based on the organizational processes. It gives importance to the involvement and commitment of the top management in implementation, management and continuous improvement of the QMS. It is expected that the new specifications will also eliminate complacency in the audition process by emphasizing the evaluation of the effectiveness and the efficiency of various organizational processes.

References

1. Bandyopadhyay, J. K., *QS 9000 Handbook: A Guide to registration and audit,* St. Lucie Press, Florida, 1996.
2. Stamatis, D. H., *Integrating QS 9000 with your Automotive Quality System*, ASQC Quality Press, Milwaukee, Wisconsin, 1995.
3. Ding, Danhong, *A study of quality management systems: QS 9000 and VDA 6.1 to recommend a harmonized system*, A Thesis presented to the faculty of the Department of Industrial Engineering, University of Houston, May 2000.
4. Mary Madigan, QS 9000 Quality Standard for suppliers to the Automotive Industry, National Standards Authority of Ireland: http://www.nsai.ie/Certification_Services/Quality_Management_Systems_QMS/VDA_6.1.shtml
5. VDA 6.1, BSI Management Systems, http://emea.bsi-global.com/Automotive/VDA61/index.xalter
6. The new global automotive quality management standard ISO/TS 16949:2000 http://emea.bsi-global.com/Automotive/ISOTS16949/TSArticle.pdf
7. Whitmore, Karen and Kalogeridis, Carla, ISO/TS 16949: Here at last, Quality Digest Magazine, January 2003, http://www.qualitydigest.com/oct02/articles/01_article.shtml
8. ISO/TS16949: 2002 Questions and Answers, http://emea.bsi-global.com/Automotive/ISOTS16949/TSQandA.xalter
9. ISO 9001:2000 FAQ, Quest Analytical Incorporation http://www.questanalytical.com/ISO9000/2000/2000_FAQ.htm
10. Smith, Radley M., *Making the transition from QS-9000 to ISO/TS 16949*, MRI: Articles, July 9, 2002, http://www.mri-inc.com/articles/qs9k_16949_rad.htm
11. Smith, Radley M., *Comparison of Requirements: ISO/TS 16949:2002 vs. ISO/TS 16949:1999 & QS 9000*, The Informed Outlook, May 2002
12. *Benefits of ISO/TS 16949:2002*, AEC Ltd., Benefits, http://www.aecltd.com/benefits.htm

FAROUK G. ATTIA

Dr. Farouk Attia is an Associate Professor of Mechanical Engineering Technology at the University of Houston, where he has taught since 1986. He has over 30 years of educational, research and industrial experience in the fields of Mechanical Engineering, Manufacturing and Automation, and Mechanical Systems Design. Dr. Attia has received several grants from NSF, Texas Higher Education Coordinating Board, and the Society of Manufacturing Engineers. He presented and published numerous articles in ASEE, AIAA, ASME, and SME conferences and journals. Dr. Attia is an active member of American Society for Engineering Education (ASEE), Society of Manufacturing Engineers (SME), and American Society of Mechanical Engineers (ASME).

JIGNESH RATHOD

Jignesh Rathod is a Lecturer at the University of Houston, College of Technology. He received his M.S. in Manufacturing Systems in December 2003, from the University of Houston. He holds an MBA and a B.S. Degree in Production Engineering from India. Before returning to graduate school for the Masters Degree, Jignesh spent over 5 years as a Project Engineer in a Pipe Fittings Manufacturing Company in Baroda, India.