
RESEARCH PAPERS
FACULTY OF MATERIALS SCIENCE AND TECHNOLOGY IN TRNAVA
SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA

2013

Number 33

**REVIEW OF SPECIAL STANDARDS IN QUALITY MANAGEMENT
SYSTEMS AUDITS IN AUTOMOTIVE PRODUCTION**

Yulia ŠURINOVÁ

Abstract

Quality management systems (QMS) in automotive industry generally have several differences in comparison with other industrial branches. Different customers have their own specific requirements, including requirements for quality audits. Audits are one of the core-tools of quality management to make the PDCA (Plan – Do – Check – Act) cycle work. As a matter of fact, compliance with ISO/TS 16949:2009 requirements is a condition for supplying the automotive industry. However, there are some standards which co-exist together with the ISO 9001 based management systems and technical specification for QMS in automotive ISO/TS16949. Which are those specific standards in automotive industry and what standard to use and why – those are the questions to be answered in this paper. The aim of the paper is to review what standards are used for audits implementation in automotive industry in the Slovak Republic, and why the organizations keep following those “extra” standards even if certification for ISO/TS 16949 is required by all the car makers. The paper is structured as follows: after short introduction to the topic and related terms, presented is our methodology. In the third section, the achieved results are discussed. And finally, the principal findings of the paper, limitations and conclusions are presented.

Key words

quality management system, automotive production, customer specific requirements, audit

INTRODUCTION

Automotive companies are finding that globalization offers many challenges and opportunities. By establishing an integrated management system, companies can manage the complexity of a global operation so that they can leverage these opportunities where it makes sense for their business. Within times of economic crises, each organization makes its best to effectively manage their internal and external processes. It finally leads to the establishment of their specific requirements for suppliers. It has become not enough to build the quality management system according to ISO 9001:2008, not even enough to meet the requirements of ISO TS 16 949:2009 which was developed especially for the automotive production. It is

Ing. Yulia Šurinová, PhD. - Institute of Safety, Environmental and Quality, Faculty of Materials Science and Technology in Trnava, Slovak University of Technology in Bratislava, Paulínska 16, 91724 Trnava, Slovak Republic, e-mail: yulia.surinova@stuba.sk

important nowadays to meet the specific requirements of each customer (Šurinová, 2011). Modern companies have to adapt their products precisely to customer needs, and therefore parameters of manufactured products are adjusted to the individual requirements of customers. Different customers determine their specific requirements based on their special market strategy in order to satisfy customers' needs (Saniuk, 2013). Customers' special requirements are often based on the manuals of the American quality management standards QS 9000 or the European standards for quality management VDA. Globalization brings best improvement tools and methods to the world business, which have been developed in different countries and companies in the world. Organizations help each other to improve their internal and external processes. Using the same tools for the same processes in different organizations in the world will help their suppliers who can use familiar techniques to communicate with different customers and satisfy different customers' needs (Šurinová, 2011).

Organizations exist for a purpose, sometimes set out in a Mission or Objectives; then they plan and act in ways intended to achieve these objectives (Woodhouse 2003). An organization is exhibiting quality if it does what is necessary to achieve its goals, and a quality audit checks an organization's effectiveness in achieving its goals. A number of structured approaches to quality have been proposed, and a long-standing one is the ADRI sequence (approach, deployment, results and improvement). The first three steps correspond to the three stages of a quality audit, and the explicit inclusion of the last steps shows how quality audit can lead to quality improvement (Woodhouse 2003).

DESCRIPTION OF THE APPROACH, WORK METHODOLOGY, MATERIALS DESCRIPTIONS, EXPERIMENTS

The ISO/TS 16949:2009 is an automotive industry-specific customer mandatory requirement. Undoubtedly, there are plenty of customer specific requirements for quality auditing in automotive production. Even in the field of quality audits, some customers do not seem to know what they want. In automotive production, ISO/TS 16949 certification is required; on the other hand there are VDA standards which are required by the German companies. The ISO/TS 16949:2009 is based on ISO 9001:2008 and the process approach is followed there. However, careful studies show, that the "process approach" is not emphasized in VDA6 series. We can state now, that VDA6 series should be treated as another customer specific requirement and the organization using those standards must be extremely careful with the VDA6 requirements implementation. In other words, sometimes we need to design, develop, and manage a process beyond the VDA standards (just like some supporting process), so it may be difficult for organizations to find an answer how to deal with it.

To fill this gap, building on the available literature, we attempted to verify the *study's hypothesis*: VDA6 series should be treated as a customer specific requirement which can improve the auditing system in an organization.

To test the hypothesis, a *literature search* was carried out. The core job was performed reviewing the VDA6 series standards requirements and comparing the fresh revision of the VDA 6.3 2010 with the previous standard revision. Besides, the ISO/TS16949:2009 special requirements were reviewed. To verify the review results, the information available in the article was validated in various Slovak automotive supplying organizations. To make conclusions, the *synthesis* method was used to prepare the table comparing the VDA6 series standards with ISO/TS 16949. The concept of narrative is underlined as a key to discovering the relationships between the standards.

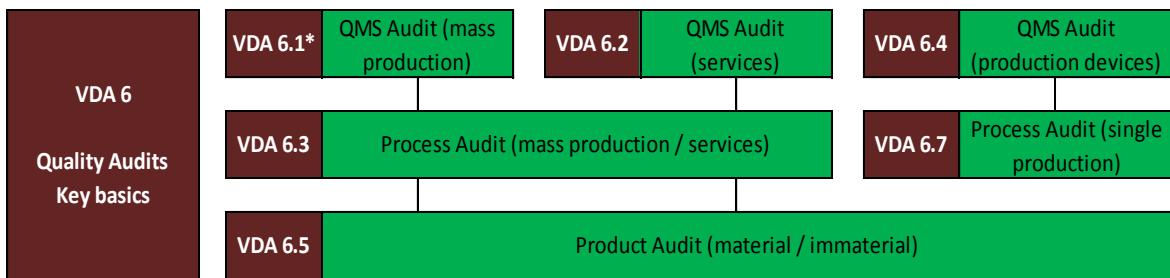


Fig. 1 VDA 6 series structure (VDA 6, 2006)

This paper is based primarily on an extensive literature review of the related standards, including the analysis and synthesis of domestic and foreign professional literary sources, mainly studies, documents, journals related to this topic, as well as textbooks, websites etc. It is a descriptive investigation. Spread sheets and word expression interpretation were used as complementary methods.

VDA6 series review

Increasing requirements in automotive production make organizations change and continuously improve quality management system. The German automotive industry is recognized on all sides as having successfully followed a premium strategy – developing brands which stand for high performance and high quality and production values. The aim of VDA standards development is reaching Automotive Excellence (VDA 6, 2006). Quality strategy by VDA is a complex quality management throughout the product's lifecycle. Organization's processes have to be monitored, so that processes' reliability can be ensured and defects occurrence prevented. Processes and system audits are the core-tool for continuous improvement. VDA6 (2006) series consists of totally seven standards (Figure 1).

Having compared VDA 6 series and ISO 19011:2011 it can be concluded, that VDA 6.x standards are more specific with their requirements. The VDA 6 standards give us specific formulas of how to determine the audit range, how to quantify the analysed system/process effectiveness and establish requirements for auditors.

It is true that some of the VDA6 series standard indicate the evaluation system which sets the rules to quantify how the analysed process or system meets the requirements. For example, according to the VDA 6.3, each analysed process is evaluated according to the scale:

- 0** (requirements not met),
- 4** (requirements not enough met or there are significant deviations),
- 6** (requirements partially met or there are bigger deviations),
- 8** (requirements mainly met or there are small deviations),
- 10** (requirements met).

Having analysed the VDA6 series standards, we can state that different standards from the VDA6 series have their own evaluation criteria. Questionnaires (for VDA 6.1 and VDA 6.3) or process signs (for VDA 6.7) may serve as an example of audit criteria. Each of these standards has also its own evaluation formulas which help to quantify the degree of meeting the requirements on a process/system. VDA 6.2 which was developed for auditing services in automotive industry cites ISO 9001 and sets special requirements for services, considering

ISO/TS special requirements. Further on, only the most widely used VDA 6 series standards will be described.

VDA 6.1 Quality management system audit

VDA 6.1 is a special standard which added some special field-specific requirements for quality management systems audit and had some special features related to ISO 9001 (Štětinová, 2005). In its content, it substantially covers all elements of ISO 9001 and partly goes beyond. VDA6.1 provides a questionnaire for assessing a company's quality system (Klaus J. Zink, 1998). Comparing ISO 9001 and VDA 6.1, there are some specific areas in VDA6.1 which are not covered in ISO 9001. Those are (VDA 6.1, 2010):

- Financial accounting in QMS part 05 (methods of reports writing, internal quality costs, external quality cost);
- Organization strategy (business plan including cost, sales, quality, etc., performance indexes evaluation: the whole factory indexes, benchmarked indexes);
- Contracts review/marketing quality ;
- Design management (best practices of implementation);
- Handling, warehousing, packaging;
- Quality records management (customer information);
- Service (on time warning system).

VDA 6.1 is divided into two main parts: Management and Products, and Processes. VDA 6.1 has special formulas to evaluate the quality management systems efficiency. According to the special questions and the formulas, organizations have to be at least 90% efficient to be VDA 6.1 certified (Štětinová, 2005).

VDA 6.1 has been valid since 1998. Since April 1, 1999 this standard has been obligatory for all the German automobile producers. The aim of the standard was to make the automobile producers continuously improve their processes, prevent problems occurrence, eliminate critical factors in production systems and others. The standard was based on ISO 9001:1994 and was lately revised in 2003 (Štětinová, 2005). The standard has not been revised according to the ISO 9001:2008 due to the fact, that registration to ISO/TS 16949 is now accepted instead of VDA 6.1.

To conclude the above mentioned, it is evident, that VDA6.1 audits standard used to be widely implemented in automotive production, but in the light of the current research, we can conclude, that it is being replaced by ISO/TS 16949 general specifications for quality management in automotive industry.

VDA 6.3 Process audit for mass production

VDA 6.3 is one of the most widely used standards for the German vehicle makers supplying factories. It is an excellent tool for process audits within the automotive industry acting as a guideline for performing audits. According to Cameron (2001), it provides information on the significance and application scope of a process audit over the entire product life cycle. It defines the audit process, the criteria for evaluation of the process, audit results and the requirements of the processes. At the heart of the standard, each step in the

process is modelled with six links and is governed by the Deming Loop – Plan Do Check Act. There are three grades that an organization can reach under VDA 6.3 – A, B & C. This means that an organization can pass the audit, but still have a scope for further improvement (Cameron, 2011).

There is no doubt, that VDA 6.3 defines a process based audit standard for evaluating and improving controls in a manufacturing organization's processes. In order to continuously monitor and improve processes in organizations and to provide processes' reliability, the VDA 6.3 was designed. Together with VDA 6.1 and other VDA6 series standards, it may be treated as customer specific requirement of the European (German) automobile producers. The VDA 6.3 standard was designed in 1998 and revised in 2010 in order to follow the changing environment in automotive production. Processes risks and weaknesses as well as the interactions between processes have to be followed. In other words, revised in 2010, the standard was comprehensively restructured to reflect the changes in ISO 9001:2008 and customer specific requirements in the automotive industry.

Having compared the latest 2010 revision with the previous VDA 6.3 standard version, the following new aspects in 2010 revision were modified:

- Requirements on risks analysis and project management were added;
- Feedback system importance was emphasized;
- Suppliers evaluation system was amplified and the evaluation scale was changed;
- The questionnaires have to be supplemented by "knowledge database" in order to emphasize special requirements of different processes.

The revised VDA 6.3 supports process approach and thus is still widely used to perform audits of suppliers. The standard includes the questionnaire for each audit phase. It also contains the evaluation system which provides the formula of how to evaluate standard requirements fulfilment. Besides, there is the supplier categorization matrix included in the VDA 6.3.

In particular, the standard can be used by any organization, either for internal process audits, or for evaluating potential or existing suppliers. Compliance with VDA 6.3 is mandated by some vehicle makers and encouraged by others. VDA 6.3 provides an opportunity to master some of the tools and approaches that have helped make this success possible. VDA 6.3 is particularly useful in any sector that wants to follow a premium strategy and ensure that the supply chain is capable of supporting the approach to global competitiveness (Cameron, 2011).

ISO/TS 16949:2009

It is true, that most production enterprises in Slovakia have an implemented management system; however, it is implemented with different levels of application of fundamental principles derived from relevant documents. Based on the VEGA research project "Prospects for the development of quality management in relation to market requirements in SR", which was implemented in the previous period in the STU, it was found that a good level of the principles of quality management application is in the automotive industry which is related to the requirements of ISO TS 16 949 (Paulová, 2010).

The ISO/TS 16949:2009 is an automotive industry-specific version of ISO 9001:2008. It adds a supplemental requirement unique to the automotive industry. ISO/TS 16949 intends to

provide not only a standard for auditing, but a systematic method to improve quality. The most important of these relate to what is referred to as the automotive core tools, which include:

- Advanced product quality planning (APQP) or VDA2's PPF (Production Process and Product Approval). The fifth edition of the VDA volume 2 was fundamentally revised in 2011 and adapted to the current automotive demands. Correlations to existing VDA volumes (e. g. maturity level assurance, VDA 6.3) are highlighted and integrated. The APQP as well as PPF provide common guidelines for a structured approach for defining and establishing the steps needed to ensure a quality product and robust production processes.
- Production Part Approval Process (PPAP) or VDA2's EMPB (Erstmusterprüfbericht). These methodologies are designed to provide evidence that all customer's Engineering design records and specification requirements are properly understood and fulfilled by the manufacturing organization. According to Shrotri (2012), the tools were designed to demonstrate that the new established manufacturing process has the potential to produce a product that consistently meets all requirements, and actual production runs at the quoted production rate.
- Failure modes and effects analysis (FMEA). It is a systematic, proactive method for evaluating a process to identify where and how it might fail and to assess the relative impact of various failures, in order to identify the parts of the process that are most in need of change.
- Measurement systems analysis (MSA). This methodology provides an introduction to the measurement system analysis, along with the guidance on how to conduct measurement system studies to ensure the quality of data used for the product and process evaluation.
- Statistical process control (SPC). This methodology provides an introduction to the statistical process control and presents general guidelines for selection and application of statistical techniques to monitor, analyse and improve production and supporting processes.

In order to perform an audit of core-tools of the automotive production, the auditor has to be specially trained on related core-tools (Kausek, 2006). Some companies (Ford and General Motors) have special requirements for auditors' trainings. Application training, however, does not always provide an insight into how to audit these tools. By combining knowledge of the methodology with the audit techniques of knowledge, the quality system auditor can be expected to find the systematic weaknesses present in the quality planning process.

According to Kausek (2006), auditing ISO/TS 16949 requirements on Quality management system requires the auditor to understand the requirements of these and other additional automotive-specific requirements, and how they fit within the overall structure of the quality management system.

Except for the special core-tools of auditing, the audit according to ISO/TS 16949 should evaluate all the processes built in the audited organization. In case of ISO 9001 certified organization, usually ISO 9001 requirements have to be checked. In case of ISO/TS certification, the auditors have to work with the ISO/TS requirements and plenty of others customer specific requirements.

Every year, the International Organization for Standardization (ISO) performs a survey of certifications to management system standards. The survey 2011 shows, that the number of

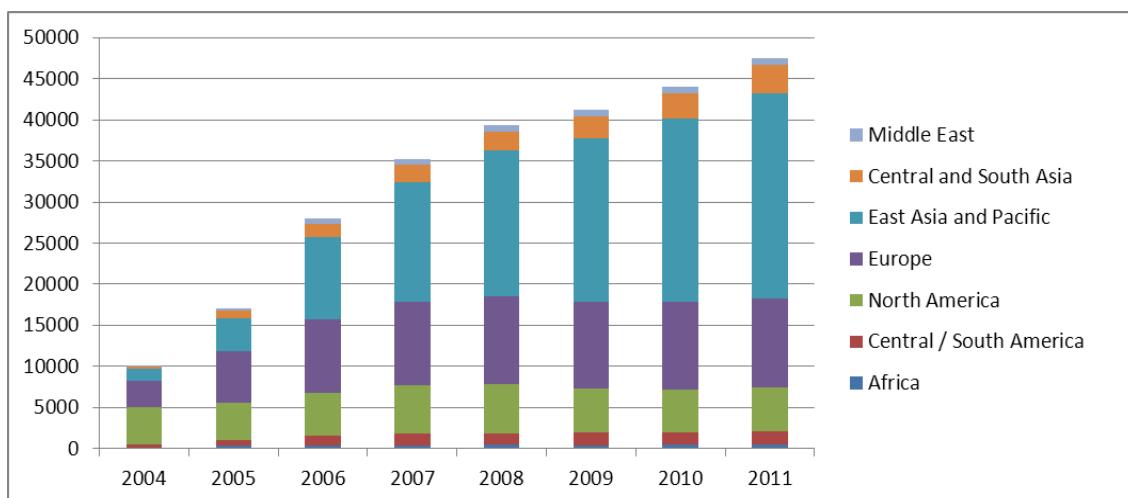
certificates of ISO/TS 16949 continuously grows from the year 2004 in each region all over the world (Graph 1)

Undoubtedly, this is due to the expansion of the automotive industry, but this fact also suggests that the standard is highly efficient; otherwise, it would not be so widely used.

DESCRIPTION OF ACHIEVED RESULTS

Since the early 1980s when quality emerged as an important facet of competition, researchers and practitioners have been trying to empirically test the relationship between quality management and performance. Early publications reported anecdotal evidence of the benefits of quality management. These were followed quickly by surveys on the benefits of quality practices conducted by consulting firms and business organizations (Hiam, 1993).

Several empirical studies have explored the relationship between quality management practices and quality conformance. For instance, (Flynn, 1995) explored the quality management practices of high-, medium-, or low-performing plants based on self-reported yield rates. The results showed that process control was used more often by high than low performers. However, the other statistically significant quality management practices (employee involvement, new product quality, concurrent engineering, feedback, and maintenance) showed that the high and low performers had high usage levels, while the medium performers had lower usage levels of these practices. The authors suggested that perhaps low performers, aware of their problems, were emulating the practices of high performers but had not yet attained the performance benefits (Seungwook, 2001).



Graph 1 Number of ISO/TS 16949 certificates (ISO Survey 2001)

We make it absolutely clear that VDA6s series have some benefits in comparison with ISO/TS 16949 (Figure 2), representing a specific tool to increase the efficiency of the QMS. In fact, VDA standards set some further requirements on automotive suppliers which can help organizations to improve the processes efficiency using the approved and validated standard. However, VDA6.x can be treated as a customer specific requirement and must be applied if it is a customer's special requirement. However, the VDA standards may serve as a guideline for the internal process audits implementations or form the basis for the suppliers' evaluation system even for the organizations which customers require the VDAs usage.

VDA 6.x ISO/TS 16949

<input type="checkbox"/>	customer specific requirement
<input type="checkbox"/>	specifies how to meet the requirements
<input type="checkbox"/>	applicable in mass / single production
<input type="checkbox"/>	applicable for services
<input type="checkbox"/>	may serve as an organizations categorization tool
<input type="checkbox"/>	obligatory for most automotive suppliers
<input type="checkbox"/>	tells what to reach, but not how to reach it
<input type="checkbox"/>	applicable in mass production
<input type="checkbox"/>	no special requirements for services
<input type="checkbox"/>	no special evaluation system provided

Fig. 2 Comparing VDA6s and ISO/TS 16949

Despite those reasons, the fact is that ISO/TS 16949:2009 is the only quality management standard for automotive industry which is recognized and accepted by each car maker all over the world. The VDA6.x standards are usually required by the German organizations and are co-integrated together with ISO/TS 16949 requirements.

CONCLUSION

Audit contributes to the achievement of business goals and it has more positive than negative effects on business performance. Therefore, the paper demonstrates how to use various audit standards not only to assure the conformity of the QMS with the standard's requirements, but also to assure business improvements using optional specifications. The results obtained confirmed the study's hypothesis. The ISO/TS 16949 standard is highly efficient for the quality management systems implementation and auditing, nevertheless, in practice, there are some commonly known and used standard which can help organizations perform the audits according to the verified and validated special formula (VDA6.x are the examples of such standards). This evidence is consistent with the answers of the individual organisations which we interviewed in order to verify the survey results.

Audits are the source of quality information and the audit outcomes and results should be used in terms of project management. This paper was supported by the VEGA project 1/1203/12 "Information quality management within the project management in industrial organizations in SR".

References:

1. CAMERON, L. VDA 6.3 Process Audit – an in-depth manufacturing process audit tool in SMMT Industry Forum 2011. Dostupné na internete: <http://www.industryforum.co.uk/articles/vda-6-3-process-audit/>
2. FLYNN, B.B., SCHROEDER, R., SAKAKIBARA, S. 1995. Determinants of quality performance in high- and low-quality plants. *Quality Management Journal* 2 (Winter), pp. 8–25.

3. HIAM, A. 1993. Does quality work? A review of relevant studies. *Report No. 1043*. Conference Board, New York.
4. KLAUS, J., ZINK, VOSS, V. Quality in Germany - an overview in The TQM Magazine, **10**(6), pp. 458 – 463.
5. KAUSEK, J. 2006. *The management system auditor's handbook*. Milwaukee, ASQ Quality press. ISBN 978-0-87389-670-2
6. PAULOVÁ, I. et al. 2010. *Perspektívy rozvoja manažérstva kvality v súvislosti s požiadavkami trhu Slovenskej republiky (Prospects of management quality development regarding the marker demands in the Slovak Republic)*. Trnava: AlumniPress, ISBN 987-80-8096-129-9
7. PAULOVÁ, I. 2009. *Vybrané metódy systémového prístupu hodnotenia účinnosti a výkonnosti manažérstva kvality a komplexného manažérstva kvality (Selected methods of systemic approach to assessing effectiveness and performance of quality anagement and TQM)*. Trnava: AlumniPress, 97 p. ISBN 978-80-8096-086-5
8. PAULOVÁ, I. 2006. Skúsenosti pri vykonávaní auditov vo vybraných organizáciách SR. (Experience in audit application in chosen organizations of SR). In: *Kvalita a spoľahlivosť technických systémov. (Quality and reliability of technical systems)*: Conf. Proc. 11. Nitra: SPU in Nitra, pp. 63-66. ISBN 80-8069-707-8
9. SANIUK, A., WITKOWSKI, K., SANIUK, S. 2013. Management of production orders in metalworking production. In: *22nd International Conference on Metallurgy and Materials - METAL 2013*. CD-ROM. Brno: TANGER. ISBN: 978-80-87294-39-0
10. SHORTRI, A. P., DANDEKAR, A. R. 2012. "PPAP" an effective tool for vendor quality management. In: *International Journal of Emerging Technology and Advanced Engineering*, **2**(4), pp. 369-372. ISSN 2250-2459
11. ŠURINOVÁ, Y., PAULOVÁ, I. 2010. Globalization effects on customer specific requirements in automotive production. *Vedecké práce MtF STU. (Research papers, Faculty of Materials Science and Technology, Slovak University of Technology in Trnava)*, **18**(28), pp. 101-106. ISSN 1336-1589
12. WOODHOUSE, D. 2003. *Quality Improvement through Quality Audit in Quality in Higher Education*, **9**(2). ISSN 1353-8322
13. SEUNGWOOK, P., JANET L. HARTLEY, WILSON, D. 2001. Quality management practices and their relationship to buyer's supplier ratings: a study in the Korean automotive industry. *Journal of Operations Management*, **19**(6), pp. 695-712.
14. ŠTETINOVÁ, A., HULÍN, P. 2011. What is VDA 6.1? In: *Logistický monitor*. ISSN 1336-5851.
15. ISO Survey 2011 online <http://www.iso.org/iso/home/standards/certification/iso-survey.htm>
16. VDA 6 Quality audits – basics. 4nd edition 2006.
17. VDA 6.1 - Quality system audit, 4th revised edition 2003, up-dated reprint 2010.
18. VDA 6.2 - Quality System Audit – Services. Volume 6, Part 2, 2nd edition 2004.
19. VDA 6.3 Process audit. Volume 6, Part 3, 2nd edition June 2010, 2nd completely revised edition.
20. VDA 6.7 Process audit for single production. Volume 6 Part 7, 1st edition 2005. HADZIMA B., JANEČEK M., ESTRIN Y., KIM H.S. 2007, Mater. Sci. and Eng. A462, 243-247.

Reviewers:

prof. Ing. Edita Hekelová, PhD. – Faculty of Mechanical Engineering, Slovak University of Technology in Bratislava

doc. Ing. Iveta Paulová, PhD. – Faculty of Materials Science and Technologyin Trnava, Slovak University of Technology in Bratislava