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## **The importance of auditing the quality of the production process in an automotive company**

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The purpose of this paper is to discuss the importance of the quality audit process in the automotive industry based on literature reviews. The paper consists of an introduction, four sections and a conclusion. The paper presents the issue of quality management in the automotive industry based on the requirements of the international ISO standard, including VDA guideline 6.3 (*Verband der Automobilindustrie*).

A case study is used to illustrate the activities of a company producing car body components. The process of auditing the production process in the automotive industry is discussed using the example of the sheet steel forming process in the light of international quality standards. An analysis of non-compliance in this process based on the international automotive quality standard is presented.

**Keywords:** quality audit, automotive industry, audit documentation, quality requirements

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## Introduction

This paper presents the issue of quality management in the automotive industry based on the requirements of the international ISO standard, including VDA guideline 6.3 (*Verband der Automobilindustrie*). The purpose of this study is to discuss the importance of the quality audit process in the automotive industry based on literature reviews.

The origins of the ISO/TS 16949 quality management system in the automotive industry are presented in theoretical terms. The thesis has been formulated that the quality requirements in the automotive industry result from the application of the ISO/TS 16949 standard, which defines the special importance of quality audits for all cooperating parties and manufacturers. The following research questions were formulated to prove the thesis:

1. What are the basic concepts of quality audit?
2. What are the origins of quality standards in the automotive industry?
3. What types of quality audits are used in the automotive industry?
4. What are the process and requirements of a VDA 6.3 production process audit?

The audit of the quality process based on a company involved in the production of car body components is discussed in the light of international quality standards, using the sheet steel forming process as an example. An analysis of non-compliance in this process based on the international automotive quality standard is presented. The article consists of an introduction, four thematic sections and a conclusion.

A study of the application of international quality standards was carried out using the source literature and the results of a participant observation study in a Chinese company that produces body parts for well-known car manufacturers.

## Quality audit in the automotive industry

The first historical references to quality can be found in the records of the ancient Code of Hammurabi from around 1700 BC. The code states that a mason should be punished by death if the house he builds collapses and causes the death of the builder (Gudanowska, 2010). Today, we should refer to the study of the ISO 9000 series. This was published in 1987 (Kolman, 2009).

The production of bodywork components in the automotive industry plays a major role, as the bodywork is the basis for the assembly of all components and must meet very strict quality and dimensional requirements. In recent decades, modern production lines and quality management systems have significantly improved the quality and repeatability of the components produced. Globalisation and the crisis of recent years have had a significant impact on many companies, especially in the automotive industry, which reflects the progressive processes in the operation of supply chains and often guides their development (Muzyczka, 2011). The changes associ-

ated with globalisation and the emergence of new markets have gained momentum and clearly indicate future locations for production and sales development. Over the past few years, China has occupied a special place both as a market for car buyers and as a country where cars are produced. The pace of today's global manufacturing environment demands constant attention to quality and consistency of production. In the automotive industry, effective quality management is crucial and affects every company in the long supply chain (*Quality concept in Knauf Automotive*, n.d.).

The automotive industry includes:

- Automotive components with assembly.
- Two-wheeled vehicles, three-wheeled vehicles, four-wheeled vehicles.
- Passenger cars.
- Light commercial vehicles (LCVs).
- Heavy trucks and buses/coaches.

Quality auditing to ISO 19011 is essential in many industries due to the complexity of today's globalised world.

The first references to the need for auditing date back to ancient Rome, while the blooming period of the institution of auditing in its present form occurred in the 19<sup>th</sup> century (*Wielka Encyklopedia PWN*, 2001). Initially, the audit formula was based on the action of independent experts, centred on accounting records and aimed at verifying the accuracy of the records. Modern auditing focuses on improving the organisation, rather than looking for irregularities. Wrongly – but still very often – a quality audit is therefore compared to an audit to find the irregularities that have occurred and those responsible (Russell, 2009). The definition of a quality audit is formulated as follows: “Audit is a systematic, independent and documented process for obtaining objective evidence and evaluating it objectively to determine the extent to which the audit criteria are fulfilled” (*ISO 19011 Guidelines for auditing management systems*, 2018).

## **ISO/TS 16949 Automotive Quality Management System**

Quality standards have evolved and in 1999 the ISO/TS 16949 standard was established. This standard was developed by the International Automotive Task Force (IATF), the Japan Automobile Manufacturers Association (JAMA) and ISO/TS 176 Quality Management and Quality Assurance. Over the next decade, ISO/TS 16949 evolved into the version created by ISO 9001.

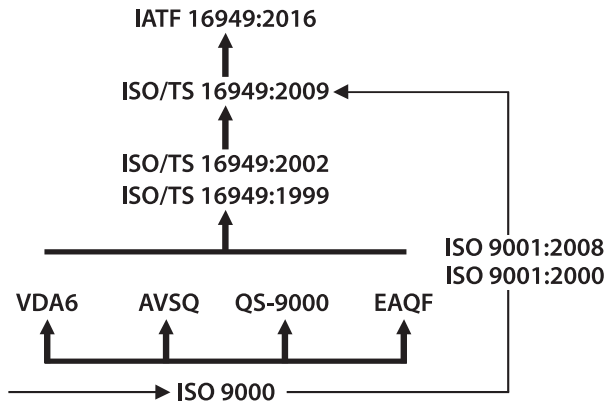


Fig. 1. The genesis of ISO/TS 16949

Source: Own elaboration by B. Jakuczek based on ISO/TS 16949 Quality Management System Agent and Auditor training materials.

## Presentation of the characteristic elements of the Automotive Quality Management System

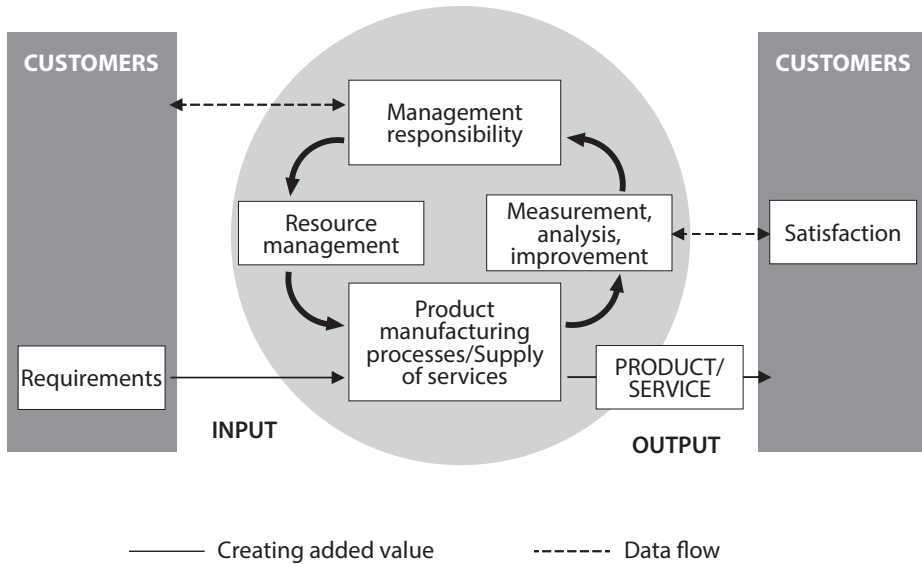
ISO/TS 16949 is a technical specification that contains a set of quality management requirements. Its development has been informed by many years of quality experience in the automotive industry, based on the quality systems approach set out in ISO 9001. There are two types of recommendations that are worth mentioning:

I. Requirements, i.e. elements that must be implemented by the organisation; if they are missing, it is considered non-compliance.

II. Recommendations, i.e. suggestions, which may or may not be implemented, and their absence cannot be considered non-compliance.

It is recommended that the adoption of a quality management system should be a strategic decision for the organisation. The ISO 9001 quality system should be continuously improved, as shown in Figure 2.

## CONTINUOUS IMPROVEMENT OF THE QUALITY MANAGEMENT SYSTEM



*Fig. 2. Continuous improvement of the quality management system*

Source: Own elaboration based on the quality management system model according to ISO 9001:2009.

An important element of quality management in a globalised environment is the recommendation to adopt a process approach when developing, implementing and improving the effectiveness of a quality management system. In the automotive industry, the most essential quality criterion is to achieve customer satisfaction, which can be achieved by meeting customer requirements. The following factors are important in the design and subsequent implementation of a quality management system in the automotive industry:

- Changing buyer needs.
- Company objectives.
- Size and structure of the organisation.
- Logistical processes carried out in the company.
- Quality of componentry and parts supplied.

The use of ISO 9001 by internal/external parties, including certification bodies, is intended to assess the organisation's ability to meet customer, regulatory and other requirements set by the organisation. The industry standard ISO/TS 16949 has extended requirements that may seem quite restrictive in the overall complexity of the automotive industry, while proposing solutions to eliminate defective product components. ISO/TS 16949 compliant features include:

- Features or parameters of the production process that may affect safety or compliance.

- Suitability.
- Functionality.
- Process effects.
- The potential for further use of the product, for example in assembly.

The organisation shall demonstrate that the customer's requirements for the definition, documentation, and monitoring of special features/characteristics are met. These characteristics are determined at an early stage in the design process and can be found on the mechanical drawings that form part of the sales proposal. Characteristics must be included in production procedures, the control plan, workplace instructions and other control activities. Such quality system management activities may include FMEA, a control plan, special features or an audit of the production process or product. FMEA stands for Failure Mode and Effects Analysis, Such an analysis is divided into a P-FMEA (Process Failure Mode and Effects Analysis) of the production process and a D-FMEA (Design Failure Mode and Effects Analysis) of the finished good.

The creation of a basic approval document and the release of the process/product for series production are essential to the proper documentation of the production process. This document is called PPAP – Production Part Approval Process. Derived from the US QS-9000 quality system, PPAP is specific to the automotive industry. The control plan is a description of the systems and processes required to control the product. It is prepared together with the FMEA and is subject to similar principles of updating and application. This is another essential document for PPAP production release and is used in the design stage of the production process. Work instructions and control instructions are drawn up based on this plan. This plan must be updated every time the product or process changes. It includes the following elements:

- Control descriptions for process monitoring, including required characteristics, measurement method, tools, range and frequency.
- The indicated measurements, which are subjected to the analysis of the measurement system.
- Information on its own and the customer's special characteristics.
- Information requested by the customer.
- Options for dealing with process instability.

ISO/TS 16949 defines very precisely the types of audit required. The first is a process audit. According to the above specification, “the organisation should audit each production process to determine its effectiveness.” The process is fairly straightforward as it involves reviewing the process map and process flow to find all the processes and preparing an audit plan. The second type, product auditing, is defined as follows: “The organisation should perform product audits at a defined frequency at appropriate stages of the production and delivery process to verify compliance with all specified requirements, such as product dimensions, functionality, packaging and labelling.”

## Quality audit and its types: ATF 16949:2006 based on the VDA 6.3 process audit

The automotive industry is highly focused on maintaining the highest quality standards in the production of car body components. The quality of the final detail, both in terms of the individual part and the assembly, is an important element in how the final product, the car, will look. Increasing demands and competition in the marketplace have created new challenges for quality management, leading to the development of the automotive industry's own quality management system standards.

The company's processes must be continuously controlled to maximise reliability (Perl, n.d.). ISO/TS 16949:2009 extends ISO 9001:2008 in the areas of production and service delivery, control of monitoring and measuring equipment, analysis and improvement of the quality management system in the automotive sector (prevention of non-compliance and reduction of deviations and losses in the supply chain). It now forms the basis of quality management systems in the automotive sector and is gradually replacing the many specifications previously used, such as VDA 6.1 (*Verband Der Automobilindustrie*), QS 9000 (*Quality System*), AVSQ (*Associazione nazionale dei Valutatori di Sistemi Qualità*) or EAQF (*Stands for evaluation, aptitude, quality, and supplier*) (Wieszala, 2012: 111).

In the event of non-compliance, timely diagnosis of problems provides an opportunity to respond as quickly as possible and put corrective mechanisms in place. Audit is therefore a key tool for process control. Its purpose is to assess the quality capability, the prevention of defects, corrective actions to prevent their recurrence or a continuous improvement process. Ultimately, the audit provides management with an opportunity to assess the effectiveness of a particular process together with the individual elements of the quality management system.

Conducting an audit always has a specific purpose, which can be described as a quality capacity assessment. This should result in the ability to control processes and make them resilient to disruptions. Another important element is prevention, i.e. recognising, identifying and implementing measures to prevent defects from occurring in the first place. It is crucial to define corrective actions, which consists of analysing already known non-compliances and implementing procedures to prevent their recurrence. A key activity is the continuous detail improvement (KVP) process to optimise the system as a whole. Implementing actions from the process audit helps to improve the process, making it more efficient and resilient. In summary, the audit as a quality management assessment enables management to evaluate the individual components of the QM system (*VDA. Verband der Automobilindustrie*, 2016). The standard currently covers the following areas (Stamatis, 2021):

P1 – Potential audit.

P2 – Project management.

P3 – Development and process planning.

P4 – Implementation of development and product.

P5 – Supplier management.

P6 – Production.

P7 – Customer service.

A process audit can be planned (targeting a system or project) or unplanned (following a problem). The planned audit is embedded in the company's quality management system, i.e. it is carried out according to a plan. Such an audit covers suppliers with a certified quality management system, and is only carried out to a limited extent for processes directly related to supply. This is deliberately the case to keep costs to a minimum. A project-oriented audit, on the other hand, is carried out at an early enough stage to identify deficiencies and to implement changes. We usually deal with it during design and planning (Russell, 2002: 12).

Off-plan audits are carried out as a result of an unforeseen non-compliance. They are carried out at every stage of the entire project to address deficiencies and check that critical features of the process have been implemented. This type of action is very useful in reducing the causes of errors and in the implementation of corrective actions. Some reasons for an off-plan audit are as follows:

- Customer complaints.
- Decline in quality.
- Modification of the production process.
- Production problems.
- Cost reduction.
- Request from another department.

A process audit can be an internal audit (carried out by an internal audit department), an external audit (carried out by a customer of a particular company) or a third-party audit (carried out by an external organisation). Whatever form it takes, an audit can cover any service or process: marketing, design, purchasing, production, distribution, customer service, maintenance, and recycling.

**Tab. 1. Example of audit scope**

Type	Organisational / Functional Unit	Specific Process
Concerning the process	Mechanical working Paint shop Assemblage	Lathework Drying Bonding glass
Concerning the service	Control planning Personnel matters Logistics Plant protection	Sample assessment Staff recruitment Provision of parts Business security

Source: VDA. *Verband der Automobilindustrie*, 2016.

Conducting a process audit is based on preparing the next steps in advance. A necessary step in this process is preparation, both in terms of the conditions in the



company and the conditions of the process itself. Planning and implementation need to be accompanied by an optimisation process (Winiarska, 2008).

Examples of documents required to prepare and conduct a VDA audit are (VDA. *Verband der Automobilindustrie*, 2016):

- DIN EN ISO 9000 guidelines.
- Organisational structure, company structure.
- Company or individual department data (range of products and services, references, etc.).
- Catalogue of questions.
- Audit plan.
- Quality book, process manuals, work instructions and control instructions (internal/external).
- Assumptions arising from the VDA guidelines.
- Assumptions arising from juridical act and agreements.
- Customer requirements.
- Important product characteristics.
- Relevant process parameters.

The audit process is fixed and not subject to major changes. The audit process consists of a preparation phase, the execution of the audit process and the conclusion. At the end, an audit report and the results of the monitoring of the corrective actions taken with an assessment of their effectiveness are prepared.

The acquisition of information relevant to process evaluation does not stop with the above. Additional sources of information can also be FMEA, company targets, for example PPM (parts per million – the number of defective products per million units produced at different times), control charts, audit results, the action plan from the last audit, the repair book, etc. The analysis of these documents will certainly be a useful source of information for the preparation of the question catalogue.

Once the preliminary work process has been completed, the auditor (or audit team) proceeds to develop a catalogue of questions for the process. Before the start of the audit, the catalogue will be sent to the company where the audit will take place. There is an opportunity to discuss or clarify any points that are not understood. The next step is to agree the teams on both sides (auditors and auditees). The following issues are the subject of the findings:

- Number and names of auditors (if there is more than one auditor, a lead auditor should be selected, generally 2 for external audit and 1 for internal audit).
- Audited in the organisational/functional unit, e.g. the person(s) responsible for the process, specialists, representatives of cooperating departments/units.
- The appropriateness of involving specialists (for external audits, in consultation with the auditees).
- Participants in the closing meeting (VDA. *Verband der Automobilindustrie*, 2016).

The audit follows a pre-prepared catalogue of questions and follows the numbering order, although it may deviate from this. The opportunity to explore processes in detail is provided by the variety of “why” questions. If there are new side questions that add something useful to the audit, they can be added to the question catalogue later. Employees should also be involved through questionnaires during the audit. All statements, whether positive or negative, must be documented. Where serious deficiencies are identified, it is recommended that immediate action is taken with those responsible for the process in question.

The assessment of the questions is based on the current requirements and how they are being met. Each question can receive correspondingly: 0, 4, 6, 8, 10 points. The number of points awarded reflects the fulfilment of the given requirements (Tab. 2). For any score below 10, there must be a corrective action plan for improvement and a deadline for its implementation.

**Tab. 2. Assessment of compliance with VDA 6.3 in the automotive industry**

Number of points	Assessment of compliance with individual requirements
10	Full compliance with requirements
8	Most of the requirements met, minor deviations, potential for improvement
6	Requirements partially met, significant non-compliance
4	Requirements insufficiently met, serious non-compliance
0	Requirements not met

Source: VDA. *Verband der Automobilindustrie*, 2016.

The VDA guidelines provide a clear classification of the extent to which the requirements have been met. The classification is based on a percentage score that is extracted from the results of the catalogue of questions. The overall degree of compliance for the audited process is calculated using the formula in Table 3:

**Tab. 3. Calculation and classification of compliance to VDA 6.3**

$E_G = \frac{\text{(Total points obtained from all assessed questions)}}{\text{(Total points possible from all assessed questions)}}$		
Classification	Overall degree of compliance with $E_G$	Description of the classification
A	$E_G \geq 90$	Quality capable
B	$80 \leq E_G < 90$	Conditionally quality capable
C	$E_G < 80$	Quality incapable

Source: VDA. *Verband der Automobilindustrie*, 2016.

The process is then classified as A, B or C based on the scores obtained. Finally, the result must be checked for downgrading. The classifications will be checked against the criteria set out in Table 4.

**Tab. 4. Downgrading criteria for VDA 6.3**

<b>Downgrading from A to B despite achieving EG level &gt; = 90%</b>
At least one element of the P2-P7 process or its stage scored < 80%
P6 sub-element completion rate scored < 80%
At least one question on the list scored 4 points
At least one question scored 0 points
Overall baseline scores for process accountability, goal orientation, communication, and risk orientation are below 70%.
<b>Downgrading to C despite achieving EG level &gt; = 80%</b>
At least one element of the P2-P7 process or its stage scored < 70%
P6 sub-element completion rate scored < 70%
At least one question on the list scored 0 points

Source: VDA. *Verband der Automobilindustrie*, 2016.

The person and experience of the auditor are important elements of the overall audit. VDA requirements stipulate that the auditor should have at least two years' practical experience of process management in the automotive industry on both the manufacturer and supplier sides. In addition, such a specialist must be certified as having carried out a minimum of three process audits. This should be underpinned by knowledge of current standards and internal regulations. The auditor shall have the following personal characteristics:

- Independent.
- Impartial.
- Reliable.
- Honest.
- Objective.
- Always evidence-based.

Besides personal factors, the following skills will be required:

- Planning.
- Communication.
- Obtaining/gathering information.
- Verifying.
- Drawing conclusions (Przybylska, Rydzak, Trębecki, 2020).

The audit will be summarised in a final meeting with the participants. There is a discussion of all the negative and positive points the auditor has found during the audit. It is important to highlight those areas where immediate corrective action is required due to the risk involved. Any non-compliance findings by the auditor should

be the subject of a corrective action plan. The auditor can demonstrate the need for a follow-up audit if necessary. Such a need does not necessarily have to follow the occurrence of a non-compliance. The external audit culminates in the auditor and auditees signing a final report to confirm the discussion of the findings (Moeller, 2015).

## Summary

The importance of managing the quality of production processes is particularly relevant in the context of global supply chains, where companies from many countries work together. An example of this kind of global cooperation is the automotive industry, where components for a car are manufactured in a number of different countries. The aim of this paper was to present a literature review of quality management issues in the automotive industry, using the production process of body components of global car brands as an example. A presentation was made on the problem of quality auditing in a Chinese company in the automotive industry. Based on the literature review and the analysis of the company's qualitative documentation, the research questions posed in the introduction were answered. The basic concepts of auditing on the basis of ISO 9001 are discussed. The types of quality audits in the automotive industry are characterised and the details of the VDA 6.3 audit requirements are analysed.

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### Streszczenie

#### Znaczenie audytu jakości procesu produkcji w firmie branży automotive

Celem artykułu jest omówienie znaczenia procesu audytu jakości w branży motoryzacyjnej na podstawie studiów literaturowych. Artykuł składa się ze wstępu, czterech rozdziałów oraz podsumowania. W pracy została zaprezentowana problematyka zarządzania jakością w branży motoryzacyjnej w oparciu o wymagania międzynarodowej normy ISO, w tym wytycznej VDA 6.3 (*Verband der Automobilindustrie*).

Na podstawie badania typu case study przedstawiono działalność przedsiębiorstwa zajmującego się produkcją elementów karoserii samochodowych. Omówiono proces audytu procesu produkcji w branży motoryzacyjnej na przykładzie procesu tłoczenia stalowych blach w świetle międzynarodowych standardów jakości. Zaprezentowano analizę niezgodności w tym procesie na podstawie międzynarodowego standardu jakości w branży motoryzacyjnej.

**Słowa kluczowe:** audyt jakości, przemysł motoryzacyjny, dokumentacja audytowa, wymagania jakościowe

### O autorach

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