Matlab Application for Implementation of Automotive Audit Process VDA 6.3-2010

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Abstract *- Quality audits are used for evaluating products, services, processes and the quality system of a company. The most used audit in European automotive companies is the VDA 6.3 standard. The aim of this paper is to develop an application that assists the experts in the field of quality systems audits in auditing companies, under the VDA 6.3-2010 audit process. The proposed software product has three parts: Planning, VDA 6.3-2010 questionnaire and Finalized Audits and it provides template documents, graphical representations (Pie chart, histogram), automatic computation of the audit score, data saving and history facilities.*

Keywords – *quality audit, automotive industry, MATLAB, software application, automatic computation.*

1. INTRODUCTION

Quality, quality assurance and quality management are concepts that are emerging in an increasing extent as the central task for any enterprise that wants to exist on the globalized market, regardless of the product or service they offer, location or size. The paper layout settings must be the following:

In the context of current concerns of implementing quality systems, according to ISO standards, the audit it is considered an essential tool for achieving the goals of the company.

The main purpose of the audit is to evaluate nonconformities in relation to regulations and to develop the necessary corrective actions to eliminate such non-compliance [1].

In quality management, the term audit is used for the purposes of examining the quality of products, services, processes and the quality system of a company as a whole. Quality audit is systematic, independent and documented in order to obtain audit evidence and evaluating them objectively to determine the extent to which audit criteria are fulfilled [2].

Depending on the scope, quality audits can be: quality audit product/service; quality audit process; audit of the quality system [3].

In the last years, the audit was efficiently and successfully implemented in order to meet customer requirements, using standard VDA (*Verland der Automobilindustrie*) 6.3 process. VDA 6.3 audit standard was originally established in 1998 and revised in 2010.

Several online applications offer templates for documents from the standard, in order to bring VDA 6 to a wider use [4-5]. However, these apps do not provide graphical representations of the audit parameters, do not facilitate the management of ongoing audits, and may require an Internet connection.

Other types of auditing apps, such as [6], are developed only for iOS users. Also, working on multiple audits at the same time can be helpful, although none of the above instruments offer this facility.

Moreover, all the online applications need an increased level of protection to assure data confidentiality.

This paper presents the implementation and development of a software tool for analysing the audit process, based on current standards used in the automotive industry for auditing VDA 6.3-2010 of a quality management system. The software tools can be used by the experts in the field of quality systems audits.

The proposed application completes a series of objectives, as follows:

- The thorough analysis of the process/production audit, according to P6 VDA 6.3-2010;
- The compliance evaluation for processes and results of processes (products, services), according to VDA 6.3-2010 or another normative act;
- The detection of critical points, as sources for faults/flaws in the company's activities;
- The elaboration of intermediate documents;
- The elaboration of the audit report, which clearly specifies the total progress, based on filling out the VDA 6.3-2010 questionnaire, for the continuous process and non-conformities analyses.

The paper is structured as follows: Section II presents a brief description of the VDA 6.3 quality audit standard; Section III describes the application; Section IV presents the Matlab implementation and results and Section V concludes the paper by summarizing the advantages of the application and outlining some future development directions.

2. VDA 6.3 AUDIT

VDA 6.3 is an integrated part of a VDA 6 Quality Management System for the Automotive Industry. The core of the VDA evaluation consists of all the elements of the ISO 9001: 1995 standard, while some are supplemented with ISO 9004: 1995 and automotive specific requirements. VDA is more restrictive than the EN ISO 9001 standard [7].

Process audit is an important instrument in process monitoring. VDA 6.3 is an excellent tool for process audits within the automotive industry acting as a guideline for performing audits [8].

VDA 6.3 is a part of the VDA strategy, as shown in Figure 1:

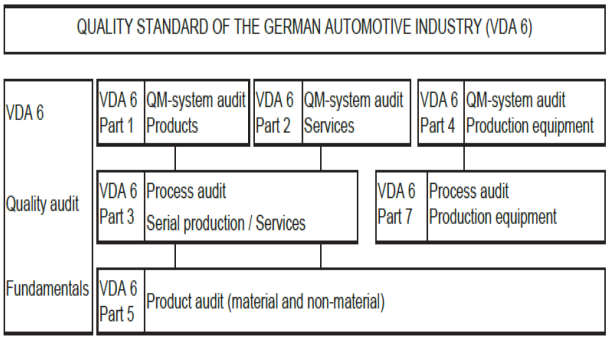


Fig. 1 – The structure of the VDA 6 standard chapters [7]

VDA 6.3 process audit has as aims: the evaluation of processes on manufacturing lines, the evaluation of new suppliers, and the consecrated supplier evaluation.

The VDA 6.3 standard can be applied in several situations that can occur in a company, such as: on the processes from the production lines of the company/supplier; before awarding, in order to prepare the award decision; new suppliers; new locations; new technology/product batches awarded; significant changes in management [8].

The results of the auditing process are: forecast on the supplier's capability in the possibility of award of contracts, the determination of the conformity degree of production, work processes in relation to reference documents on the production lines of the company/suppliers [8].

VDA 6.3 is considered useful in any sector that wants to follow a premium strategy [8]. 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 [9].

Process audits can be used both internally and externally, during the entire life cycle of the product. The auditors can be both to, internally and externally. The questions in the questionnaire are designed to be suitable for small and medium enterprises, as well as for large companies.

The evaluation questionnaire provides fundamental questions for the auditor, who will select the process elements that are relevant for the audit, based on the product's life cycle.

The questionnaire consists of: questions; minimal/relevant requirements for the evaluation; sample requirements and proof of compliance, based on the product's risk; reference information [10].

The answers will be evaluated using the following guidelines:

- 10 points: full compliance with requirements;
- 8 points: requirements mainly satisfied; minor deviations;
- 6 points: requirements partially satisfied; significant deviations;
- 4 points: requirements inadequately satisfied; major deviations;
- 0 points: requirements not satisfied [7].

Each question has the same weight. The fulfilment degree of an element of quality management is computed as the sum of obtained points, divided by the sum of all possible points. [7].

3. DESCRIPTION OF THE APPLICATION

Conducting a quality audit process usually involves the following steps [11]:

- ***Step 1.*** Review all relevant elements to the quality of audited process;
- ***Step 2.*** Development of intermediary documents, including the results of the examination items listed (checklists, review report, etc.);
- ***Step 3.*** Elaborate the audit report, specifying clearly constant non-conformities;
- ***Step 4.*** Analysis of non-conformities and their causes;
- ***Step 5.*** Establishment of the necessary corrective measures or improvement proposals being made;
- ***Step 6.*** Supervision of the correct implementation or improvement.

The proposed application helps in successfully attaining all these steps.

The implementation of the software instrument for P6 VDA process audit is based on the schematic in Figure 2. Three development directions are considered, in order to fulfil all the proposed objectives: *Planning*, *VDA 6.3 questionnaire* and *Finalized audits.*

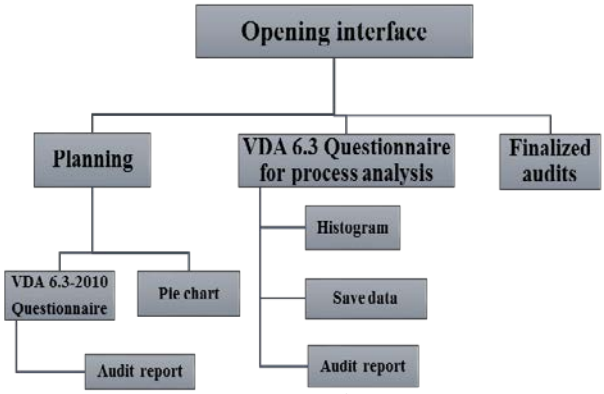


Fig. 2 – Block diagram of the application

Next, the Matlab implementation for each direction is presented.

4. MATLAB IMPLEMENTATION AND RESULTS

The application was developed using the Matlab integrated development environment, especially the GUIDE facility. The main screen of the tool allows the navigation through all three directions.

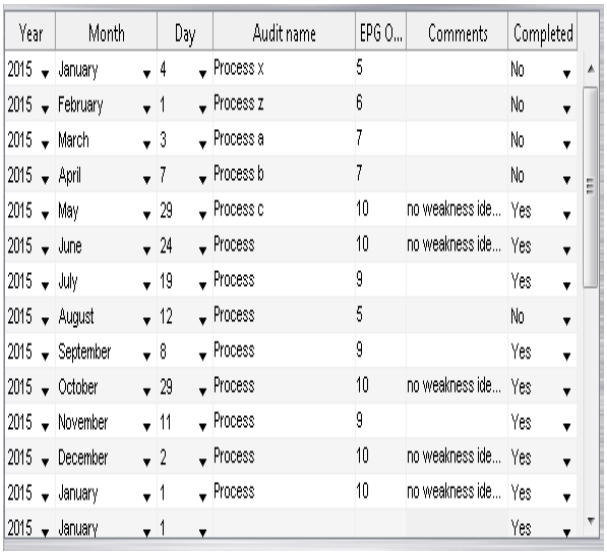
4.1. Planning

The planning of an audit involves information gathering and evaluation, as well as making decisions about the field, approach, scheduling and resources of the audit. The objective is to carry out an auditing activity that will significantly reduce the risk of drawing false conclusions about the objectives of the audit.

The planning tool is designed to automatically save the input data, when closed. The planning tool assists the user in programming future audits, filling out the audit's name, score (E_{PG}) and comments, and allows the confirmation of the completed (*Yes/No*) state of the audit. Figure 3 depicts a filled out version of the planning tool.

The planning tool also allows the graphical visualization, as a pie chart, of the ratio of finished/unfinished audits, as shown in Figure 4. For the considered example, can notice that 68% of the planned audits were accomplished and the VDA 6.3-2010 quality standard was implemented, while 32% of the audits were not finished.

New rows with all the necessary information (audit's name, score, comments, confirmation of the completed state of the audit) may be added, using the *AddRow* facility depicted in Figure 5, if all the rows of the planning tool are used.



Year	Month	Day	Audit name	EPG O...	Comments	Completed
2015	January	4	Process x	5		No
2015	February	1	Process z	6		No
2015	March	3	Process a	7		No
2015	April	7	Process b	7		No
2015	May	29	Process c	10	no weakness ide...	Yes
2015	June	24	Process	10	no weakness ide...	Yes
2015	July	19	Process	9		Yes
2015	August	12	Process	5		No
2015	September	8	Process	9		Yes
2015	October	29	Process	10	no weakness ide...	Yes
2015	November	11	Process	9		Yes
2015	December	2	Process	10	no weakness ide...	Yes
2015	January	1	Process	10	no weakness ide...	Yes
2015	January	1				Yes

Fig. 3 – The planning tool – filled out example

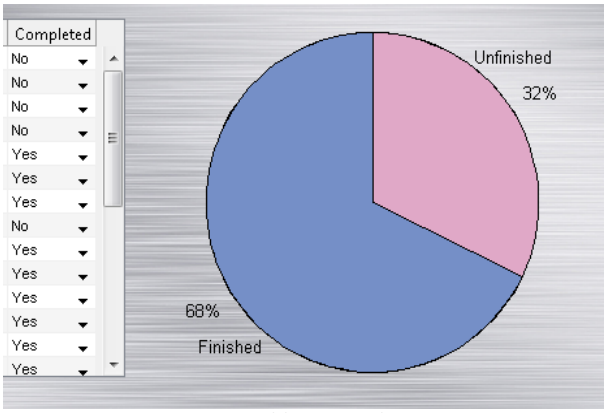


Fig. 4 – Pie chart of finished/unfinished audits

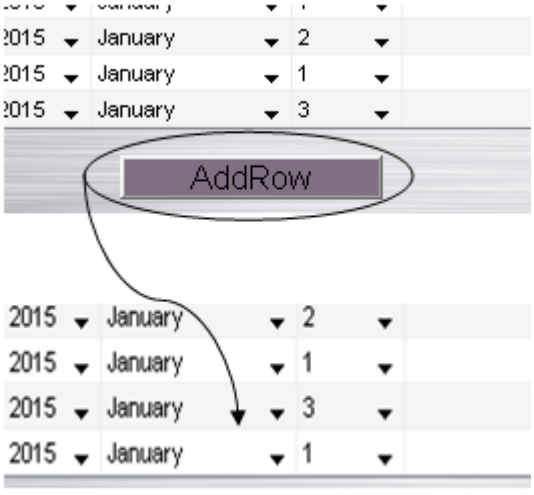


Fig. 5 – Adding a new row

From the planning window, the user can move on to the questionnaire, and then to the audit report. If the planning is completed, the application allows the direct navigation to the VDA questionnaire window.

4.2. The VDA 6.3-2010 questionnaire

The evaluation questionnaire consists of fundamental questions for the auditor. The questions are complex and address: process inputs, work content/process sequences, material resources, process efficiency level, and process outputs, all of which thoroughly verify non-conformities. Each question is to be graded with points (*0*, *4*, *6*, *8* or *10*) and further observations may also be added.

The standard P6 VDA 6.3-2010 process audit questionnaire was implemented in the software application (Figure 6). The auditor selects the number of points for each question and may also add findings that are relevant to the specific question. These free-form observations can come in handy in the future, when the auditor wants to monitor the evolution of the audit, by observing how the process has improved in time. In the questionnaire window, there are also three buttons, which allow the display of the histogram, saving the data and generating the audit report (Figure 7).

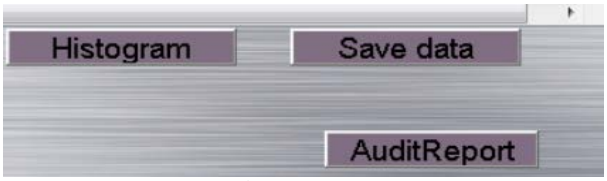


Fig. 7 – Capture from the questionnaire window

Based on all the answers, the software tool displays a histogram (Figure 8) and allows data saving, for further analyses. A score is also computed, after filling out the questionnaire, in order to establish the category of the audit.

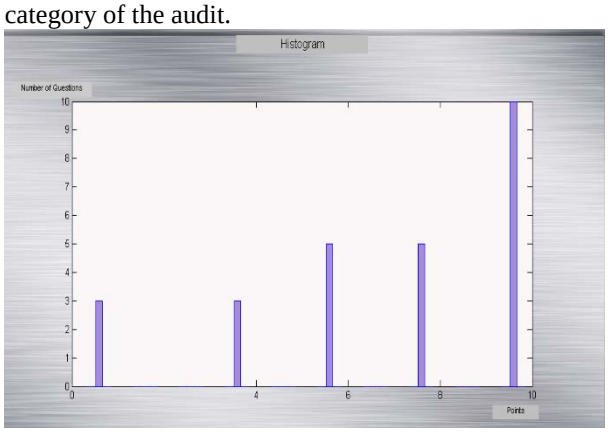


Fig. 8 Histogram of the questionnaire

The score is denoted E_{PG} and is computed as:

$$E_{PG} = \frac{\sum_{i=1}^{N} E_{Step\_of\_process\_i}}{N} \quad (1)$$

where N is the total number of evaluated steps.

Based on the value of E_{PG}, the audits can be classified into three categories, as follows:

- E_{PG} below 8 – class *C* audit and the VDA 6.3-2010 cannot be implemented. The application displays the E_{PG} score using a red background (Figure 9).
- E_{PG} between 8 and 9 – class *B* audit and the VDA 6.3-2010 can be implemented, with some restrictions. The application displays the E_{PG} score using a yellow background (F

Questionnaire VDA 6.3-2010

P6 Process Analysis Serial Production

Nr.	Question	Points	Findings
6.1.1*	Has the project been transferred from development to serial production?	10	no weakness identified
6.1.2	Are the necessary quantities / production batch sizes of incoming materials available at the right time and at the right place (stores; work-station)?	8	not at the right time
6.1.3	Are incoming materials stored appropriately and are transport facilities / packing arrangements suitable for the special characteristics of the incoming material...	10	no weakness identified
6.1.4	Are the necessary identifications / records / approvals available and allocated appropriately to the incoming materials?	4	not allocated appropiately
6.1.5	Are changes to the product or process in the course of serial production tracked and documented?	0	to many changes
6.2.1*	Are all the relevant details listed in the production and test/inspection documents, based on the production control plan?	10	no weakness identified
6.2.2	Are production operations checked / approved and are setting data logged?	10	no weakness identified
6.2.3*	Can the customers specific product requirements be satisfied with the production facilities used?	10	no weakness identified
6.2.4*	Are significant characteristics controlled in production?	10	no weakness identified
6.2.5	Are scrap, rework and setting parts kept separate and identified?	6	sometimes
6.2.6	Is the flow of materials and parts secured against mixing / wrong items?	4	no
6.3.1	Are operators given responsibility and authority to monitor the quality of product and process?	0	operators are not given respc
6.3.2	Are the operators able to carry out their allotted tasks and are their qualifications kept up-to-date?	10	no weakness identified
6.3.3	Is there a personnel employment plan?	8	not a good plan
6.4.1	How are the maintenance and overhaul of production facilities / tools controlled?	6	not all tools are controlled
6.4.2*	Can the quality requirements be monitored effectively with the test, inspection and measurement facilities employed?	8	effectively monitored
6.4.3	Are the work-stations and test/inspection areas suitable for requirements?	10	no weakness identified
6.4.4	Are tools, equipment and test/inspection facilitie stored correctly?	10	no weakness identified
6.5.1	Are target requirements set for product and process?	8	inspection corect
6.5.2	Are quality and process data logged in such a way that they can be assessed?	8	yes

Fig. 6 VDA 6.3-2010 questionnaire window

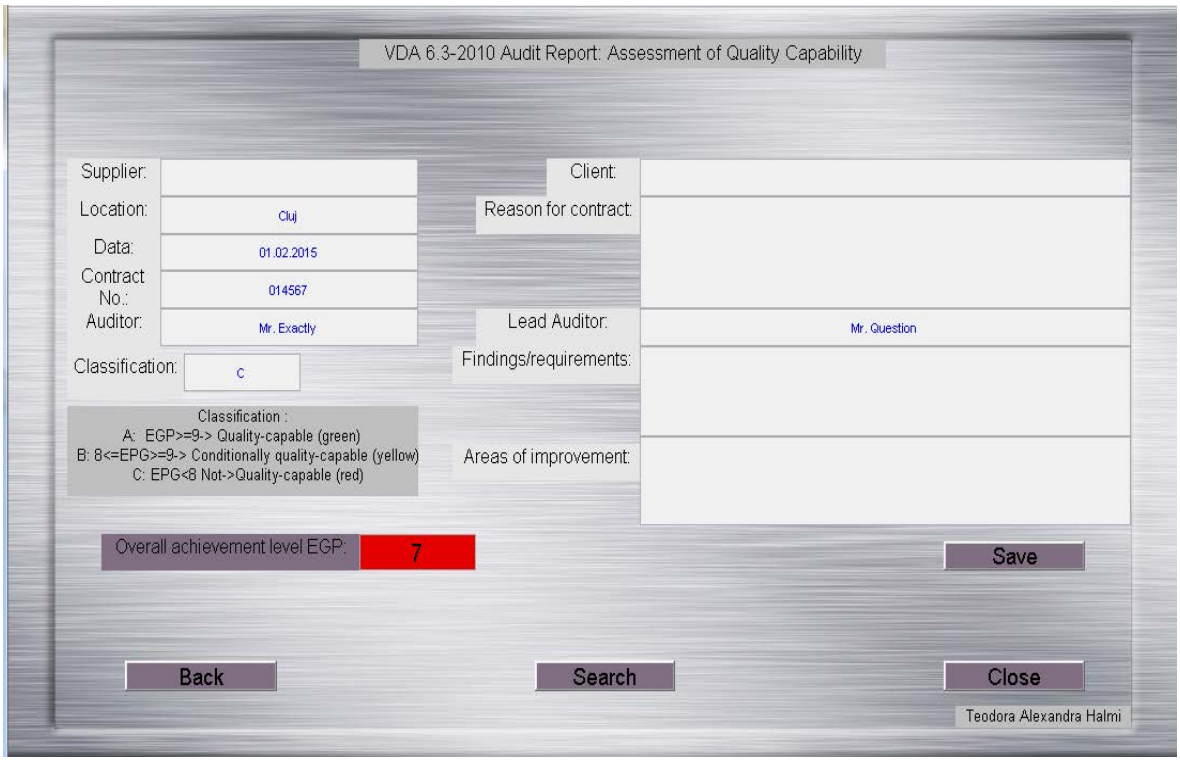


Fig. 9 Class C audit

- E_{PG} greater than or equal to 9 – class *A* audit and the VDA 6.3-2010 can be implemented. The application displays the E_{PG} score using a green background (Figure 11).

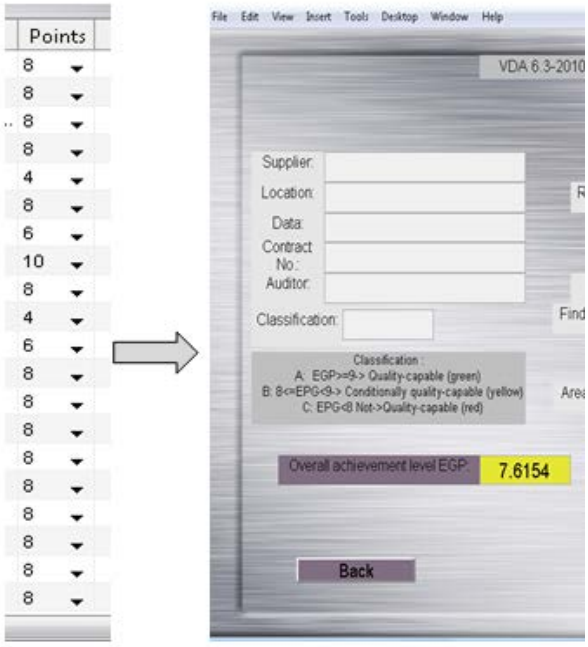


Fig. 10 Class B audit

4.3. Finalized Audits

For a clear record of the audits or future analyses of previous audits, the software allows the search and visualization of completed audits.

The audits can be saved into a Microsoft Excel file, on the PC of the audit expert. A search for previously saved audits can be performed, by using the file extension or file name.

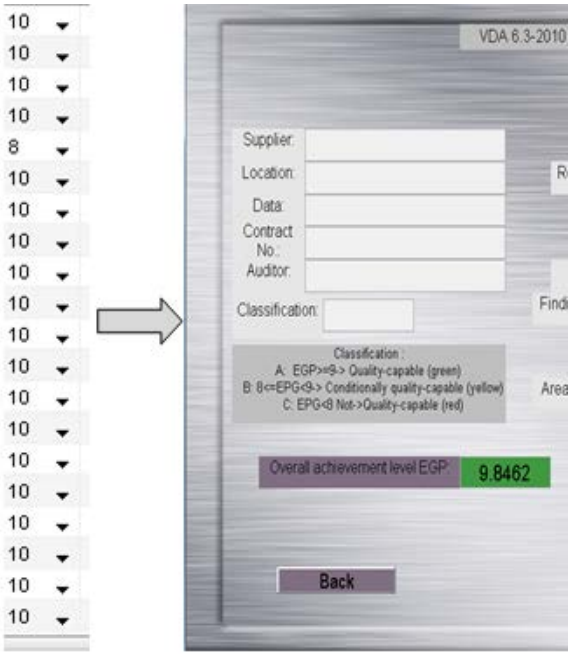


Fig. 11 Class A audit

The audit history facility can be useful when performing the audit, assuming that the expert wants to conduct multiple audits at the same time. The auditor is also able to monitor the evolution of the audit (from class C to B or even A), and whether the findings of the audit have been solved.

5. CONCLUSIONS

The paper handles the audit as a complex process and presents the development and implementation of a software application for the analysis of the process audit, based on current auditing standards in the automotive industry, namely the VDA 6.3-2010 process audit standard.

Three directions were taken into account: *Planning*, *VDA 6.3 questionnaire* and *Finalized audits*. Navigating back and forth through these sections is possible, from the main window of the application. The audit report is generated once the questionnaire is filled out.

The application aims to facilitate the process auditing; the provided results may be a decisive factor in implementing the quality standard.

The software tool has a series of advantages, such as:

- the updated graphic representation, using a pie chart, of the finished/unfinished audits ratio;
- the updated graphic representation, using a histogram, for a clear view over the fulfilment of the requirements;
- exporting the audit results in Microsoft Excel, allowing their future visualization and analysis
- the continuous improvement, focusing on faults prevention.

Further development directions include extending the application for all the chapters of the VDA 6.3-2010 standard and making it compatible with handheld devices, such as smartphones or tablets.

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