Identification and evaluation of relevance of methods and techniques of quality management in the automotive industry.

Research Results

Abstract: In years 2000-2013 research with the aim of identifying and evaluating the methods and techniques of quality management used by suppliers to the automotive industry was carried out. As part of the research the following were conducted:

- preliminary survey (using the Delphi method) in cooperation with a group of experts to identify and select methods and techniques of quality management used by OEM suppliers;
- proper survey (using a questionnaire interview) to the general population i.e. all companies which notified their quality management systems against ISO/TS standards.

As a result of the first part of research the number of methods and techniques of quality management used by companies was increased from only a few, whereas in the beginning several dozen methods and techniques had been identified. For example from Poland and the Slovak Republic were selected methods and techniques for, among other ones, the Pahlbaum, the Ishikawa diagrams, the Pareto Analysis and the TQC diagram. In the proper stage of the research the selected methods were verified by taking into consideration how frequently they were used and what daily circumstances were. The most relevant and effective were the Pahlbaum, the Ishikawa and the ISO/TS methods.

Keywords: quality management, quality management in automotive industry, quality tools.

Description of research method and data collection techniques

In order to examine the research problem the aim of the paper had to be defined at first and then achieved. In case of the following paper the aim was narrowed down to identifying the methods and techniques that were used by OEM/DPS suppliers in the automotive industry, on the one hand, and evaluating how relevant each one of them was for the QMS to be effective, on the other hand.

In consequence, the following tasks had to be performed in order to realize the general aim of the paper:

- verifying reference literature on quality management in automotive industry and specifically literature that was directly related to the formulated research problem,
- collecting documents, standards, procedures that constituted sets of essential methods and techniques and were exclusively determined in customer specific requirements (CSR),
- identifying requirements which were not formalized and had the nature of know-how used by OEM suppliers,
- describing key methods and techniques of quality management that were used in the automotive industry,
- studying the relevance of requirements on a sample of companies which underwent a comprehensive assessment both from the perspectives of supplying bodies and customers, as well as which realized their own priorities which were aimed at improving the effectiveness and efficiency of management systems and business efficiency,
- drawing conclusions in the form of recommendations specifically for supplier companies and potential suppliers for the automotive industry and more generally for all organizations wishing to improve their QMS.

In order to realize the aim of the project the following research hypothesis had to be verified: the most relevant methods and techniques used by suppliers in the automotive industry for quality management are the Ishikawa, the Pahlbaum and the ISO/TS method.

Two surveys, namely a preprint survey (S1) and proper survey (S2) were conducted in course of the research. In the proper survey (S2), a questionnaire was used as the research tool. It was given to the general population, which in this case consisted of companies operating in Poland that had certified quality management systems against ISO/TS 16949. Moreover, the direct interest of the author were the methods and techniques used for quality management.

The survey and analysis forms were carried out applied to the automotive industry and above all to the manufacturer of engine-powered vehicles. In practice, these companies were the 1st and 2nd tier OEM/DPS suppliers.

Experts representing six well-known companies, suppliers for the automotive industry, participated in the preprint survey. These experts had to meet a number of specific recruitment criteria. First of all, the main aim of the preprint survey, which was performed by means of the Delphi method, was to determine which methods and techniques of quality management, out of the wide spectrum of methods and techniques, were most relevant. Then, based on the results of
the preparatory survey a research tool (in the form of a questionnaire form) was compiled in order to conduct the proper survey. So, in other words, the preparatory survey was a prerequisite of the proper survey. The organisations that were examined held ISO 9001/14001 compliance certificates. The fact that they held such certificates also means that they cooperated within the framework of OJ/CEF supply contracts.

Identification of methods and techniques of quality management

The preparatory survey was carried out in accordance with the rules of the Delphi method and matrix formal sessions had been realised via e-mail, video and telephone conferences. The experts analysed the concentric versions. Initially the versions were related to the specific aims of the survey, defining the category of methods and techniques of quality management, the list of methods and techniques and eventually the questionnaire form.

As a result of the preparatory survey, the list of methods and techniques of quality management was narrowed down to the Flowchart, the cause-and-effect (Fishbone) diagram, the Pareto diagram, the ABC/CD (Szczupak) hierarchy, the QFD method, the FMEA analysis, the histogram, data collection sheets, SPC control charts, the PD process, the 5S1, the Layout and the Tartu Diagram. However, the respondents could also add some other methods and techniques of quality management that were used in their companies.

In order to verify the hypotheses and research aims, the following questions were put in the questionnaire form:

- Does your organisation use methods and techniques (M&T) of quality management?
- Would you place the following harms and definitions in the category “methods and techniques of quality management”?
- What are the determinants factors of using M&T for quality management?
- Which of the following M&T are used in your company?
- What is the purpose of M&T used in the company?
- What is the relevance (frequency of use and effectiveness) of using M&T in the company (1 - irrelevant, 5 - very relevant)?
- What are the reasons for limited use of M&T in the Company?
- Are reports on the use of M&T created (without using the methods and techniques)?
- How would you assess your knowledge about M&T (11 very poor knowledge and 51 very good knowledge)?

The questionnaire also included a column to collect basic personal information about the respondents.

Evaluation of relevance of methods and techniques of quality management

The S survey was performed on a group of companies with principal place of business in Poland that held ISO 9001/14001 compliance certificates. The performed survey was complete and exhaustive in nature. Due to the percentage of returned questionnaires (i.e. 23%) and other statistical parameters it was possible to infer about the whole surveyed population. The questionnaire form provided the author with data that were analysed afterwards. Subsequently on the basis the obtained data, statistical inference was conducted as to verify the hypotheses that was defined in the paper. Conducting the survey with the use of questionnaire form and according to a scenario can be regarded as a statistical observation, a statistical study and a statistical analysis [Gnozcek & Czerniecka 2004, p. 24].

To conduct the survey questionnaire form was used which was based on the assumptions that have been collected exclusively by electronic means (e-mail) and had been appropriately prepared to make use of the Internet questionnaire.

Realising the aims defined in the paper and verifying the formulated hypotheses was in the first place related to evaluating the relevance of previously specified methods and techniques of quality management.

Nearly all respondents declared that they used methods and techniques of quality management. It was an answer that could be anticipated as the use of methods and techniques of quality management is specified by ISO 9001/14001 and very often in customer specific requirements.

So the aim, i.e. identifying and selecting methods and techniques used by suppliers in quality management systems, was realized with good results. The respondents indicated which of all the methods and techniques were used (Figure 1). The following methods and techniques were used by the highest percentage of respondents (more than 65%): the FMEA, the Flowchart, the Pareto diagram, the Layout, brainstorming, histograms, control charts, the PD process, the cause-and-effect (Fishbone) diagram and data collection sheets.

Consequently, the Tartu Diagram was far less popular, even despite the fact that in literature it was often presented as a tool frequently used in the automotive industry.

1. The following sources were used in this paper in reference to the surveyed companies: the general population, surveyed population and the statistical data. The statements are also based on the research carried out by the Centre of Economic Partnerships and

2. It is to be noted in this field the following terms and expressions are found: questionnaires sent to elements and (e-mail) questionnaires which were sent electronically. Internet surveys (Webin fear


Both the SPPJ and the QED shall be recognised as highly specific tools. The first one is required only by a limited number of car manufacturers (16%) while the second one is highly specific due to the fact that only a small share of companies (respondents) carried out activities connected to QED.

 Suppliers in the automotive industry use methods and techniques of quality management primarily because of customer requirements (95%) and ISO 9001 (1989) (78%). A significant group of the respondents (62%) consider the organisational culture to be of great importance. For them the use of methods and techniques of quality management is obvious and common (Figure 2).

The classic approach to the classification of methods and techniques of quality management is related to using them for activities taken as part of the PDCA circle. The respondents were asked to choose the methods and techniques they used with the following actions:
- defining the problem,
- defining the solution,
- defining the causes,
- control the effectiveness of implemented actions, improving the QED.

Figure 1. The use of specific methods and techniques of quality management as a percentage
Source: Own study based on the results of the questionnaire survey

The purposes of using M&T in the company
Source: Own study based on the results of the questionnaire survey

<table>
<thead>
<tr>
<th>Action</th>
<th>M&amp;T in use</th>
<th>M&amp;T not in use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defining the problem</td>
<td>25</td>
<td>86.45</td>
</tr>
<tr>
<td>Defining the solution</td>
<td>21</td>
<td>81.15</td>
</tr>
<tr>
<td>Detecting the cause</td>
<td>16</td>
<td>82.15</td>
</tr>
<tr>
<td>Controlling the effectiveness of implemented actions</td>
<td>18</td>
<td>81.15</td>
</tr>
<tr>
<td>Improving the QED</td>
<td>27</td>
<td>89.15</td>
</tr>
</tbody>
</table>

Source: Own study based on the questionnaire survey

Almost all suppliers use methods and techniques of quality management as far as improving the quality management system is concerned. They are most useful when it comes to the defining problems (80.88%) and defining their causes (82.35%). The tools which support defining solutions and which are used to control the effectiveness of taken actions are more theoretical in nature (Table 6).

As it was noticed how frequently the selected methods and techniques of quality management were used it was also possible to evaluate their relevance (defined as the result of the frequency and effectiveness of their use). The most relevant methods as indicated by the respondents were the Flowchart, the FMEA method, SPC control charts as well as multi-stage problem solving methods e.g. PDPC, SPPJ. However, not only the PDPC method was considered to be relevant by the respondents, but also the cause-and-effect (Edohana) diagram (Figure 3).
The selected statistical population (suppliers certified by ISO/TS 16949 compliant) guaranteed that the methods and techniques of quality management would be frequently used. As it turned out, the motivating factors to use M&T were in each individual case different. In most cases, they resulted from necessity, i.e. requirements set by the OEM or customers. It can be certainly assumed that conscious and effective use of methods and techniques of quality management (irrespective of the reasons) is a sign of maturity as far as quality management is concerned.

The respondents (80%) admitted, though, that not all of the requirements for using appropriate methods and techniques in situations, i.e. PDCA reports, PMS/A reports etc., were complied not as the effect of teamwork, one of the stages of problem solving activities, but as a formal task which simply had to be completed.

This is caused by a number of uncompetitive factors, such as:
- The fact that such actions require much time (77.94%),
- Inexperienced staff (77.05%), and
- the fact that the employees are not sufficiently prepared to use them (72.96%) – Figure 4.

It must be pointed out that the respondents did not consider using M&T as unimportant or insignificant. On the contrary, the experts noted that all the methods and techniques could be used effectively. What is more important are their frequent use, even the lack of requirements related to their use does not contribute to the fact that such M&T are applied less frequently.
However, there are no similarly oriented people in this group. All of them felt the need to educate and develop is in particular area of expertise.

Conclusions

The author verified the common theoretical approach regarding the methods and techniques of quality management. The research also showed that comparison of the automotive industry used in practice only a limited number of the high number of methods described in literature. In addition to this, the results of the research helped to determine which methods and techniques were the most effective when it came to their use. This was key advance as effective methods can considerably support non-compliance monitoring, or taking corrective and preventive actions. The results of the conducted survey and the conclusions of the author can show actual and potential OEM suppliers (both 1st and 2nd tier) in which directions should go in order to be effective. When the summarized character of methods and techniques used in the surveyed population of companies is taken into consideration, it can be assumed that the results of the survey are also universal for all organizations utilizing the TQM strategy.

The results of the research confirmed that methods which are also the basis for creating key system documents are the most relevant ones, i.e., FMEA and PDCA, and more rarely process mapping tools (SPC) and problem solving methods - above all RE.

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References


Straszewski, P., 2009-2011, A test of the practical use of suppliers, methods and techniques used in automotive industry. Identification and evaluation of the relevant methods and techniques of quality management in the automotive industry (Ministry of Science and Higher Education, own research projects, No. N515 200426).


