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## IDENTIFICATION AND EVALUATION OF RELEVANCE OF METHODS AND TECHNIQUES OF QUALITY MANAGEMENT ON THE EXAMPLE OF SUPPLIERS IN THE AUTOMOTIVE INDUSTRY. RESEARCH RESULTS

**Abstract:** In years 2009–2011 research with the aim of identifying and evaluating the methods and techniques of quality management used by suppliers in 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) on the general population i.e. all companies which certified their quality management systems against ISO/TS 16949.
- As a result of the first part of research the number of methods and techniques of quality management used by companies was narrowed down only to a few, whereas in the beginning several dozen methods and techniques had been analysed. Six experts from Poland and the United States narrowed down the list of methods and techniques to, among other ones, the Flowchart, the Ishikawa Diagram, the Pareto Diagram, FMEA analysis and the Turtle Diagram.
- In the proper stage of the research the selected methods were verified by taking into consideration how frequently they were used and what their relevance was. The most relevant and effective were the FMEA, the Flowchart and the 8D method.

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

### Description of research method and data collection techniques

In order to explain the research problem the aim of the paper had to be defined at first and then realised. In case of the following paper the aim was narrowed down to identifying the methods and techniques that were used by OE/OES 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 realise 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 formalised 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 perspective of certifying bodies and customers, as well as which realised 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 organisations wishing to improve their QMS.

In order to realise 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 Flowchart, the FMEA analysis and the 8D process.*

Two surveys, namely a preparatory survey ( $S_1$ ) and proper survey ( $S_2$ ) were conducted in course of the research. In the proper survey ( $S_2$ ) 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 surveys and analyses that were carried out applied to the automotive industry and above all to the manufacturers of engine-powered vehicles. In practice, these companies were the 1st and 2nd tier OE/OES suppliers.

Experts representing six well-known companies, suppliers for the automotive industry, participated in the preparatory survey. These experts had to meet a number of specific recruitment criteria. First of all, the main aim of the preparatory 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 really of relevance. 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/TS 16949 requirements compliance certificates. The fact that they held such certificates also meant that they cooperated within the framework of OE/OES 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 seven formal sessions had been realised via e-mail, video and teleconferences. The experts analysed the consecutive 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 (Ishikawa) diagram, the Pareto diagram, the ABCD (Suzuki), brainstorming, the QFD method, the FMEA analysis, the Histogram, data collection sheets, SPC control sheets, the 8D process, the 5PPJ, the Layout and the Turtle 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 hypothesis 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 terms and definitions in the category "methods and techniques of quality management"?
- What are the determinant 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? ("1" signified very poor knowledge and "5" 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<sub>2</sub> survey was performed on a group of companies<sup>1</sup> with principal place of business in Poland<sup>2</sup> that held ISO/TS 16949 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 of the obtained data, statistical inference was conducted so as to verify the hypothesis 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 [Ignatczyk & Chromińska 2004, p. 24].

To conduct the survey a questionnaire form was used which by assumption had been distributed exclusively by electronic means (e-mail) and had been appropriately prepared to make use of the Internet questionnaire<sup>3</sup>.

Realising the aims defined in the paper and verifying the formulated hypothesis 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/TS 16949 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 realised with good results. The respondents indicated which of all of the methods and techniques were used (Figure 1). The following methods and techniques were used by the highest percentage of respondents (more than 60%): the FMEA, the Flowchart, the Pareto diagram, the Layout, brainstorming, histograms, control sheets, the 8D process, the cause-and-effect (Ishikawa) diagram and data collection sheets.

Concurrently, the Turtle 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.

<sup>1</sup> The following synonyms were used in this paper in reference to the surveyed companies: the general population, surveyed population and the statistical population.

<sup>2</sup> Business activity registered in Poland as defined by the Code of Commercial Partnerships and Companies.

<sup>3</sup> In literature in this field the following terms and expressions are found: questionnaires sent by electronic mail (kwestionariusze wysłane pocztą elektroniczną), Internet survey (badanie internetowe), computer questionnaire (ankieta komputerowa) [Kantewska-Sęba, Leszczyński & Piłarczyk 2006, p. 122; Mazurek-Łopacińska 2005, p. 107; Pocięcha 1996, p. 5; Maćkik 2005, p. 114-117].

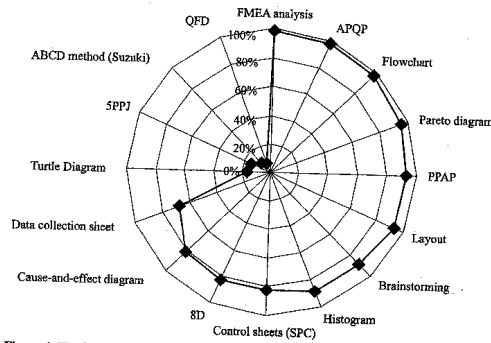


Figure 1. The use of specific methods and techniques of quality management as a percentage

Source: Own study based on the results of the questionnaire survey

Both the 5PPJ and the QFD shall be recognised as highly specific tools. The first one is required only by a limited number of car manufacturers (8D is far more frequent in use). The second one is highly specific due to the fact that only a small share of companies (respondents) realised activities connected to R&D.

Suppliers in the automotive industry use methods and techniques of quality management primarily because of customer requirements (99%) and ISO/TS 16949 (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 match the methods and techniques they used with the following actions:

- defining the problem,
- defining the solutions,
- defining the causes,
- control the effectiveness of implemented actions,
- improving the QMS.

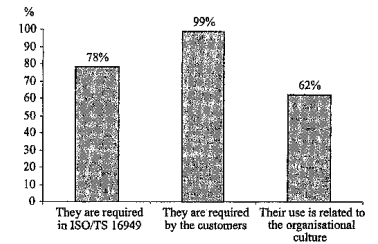


Figure 2. Main reasons for using methods and techniques of quality management

Source: Own study based on the results of the questionnaire survey

#### The purpose of using M&T in the company

Action	M&T is used		M&T is not used	
	number of respondents	percentage	number of respondents	percentage
Defining the problem	55	80.88	13	19.12
Defining the solutions	42	61.76	26	38.24
Defining the causes	56	82.35	12	17.65
Controlling the effectiveness of implemented actions	28	41.18	40	58.82
Improving the QMS	67	98.53	1	1.47

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).

As it was assessed how frequently the selected methods and techniques of quality management were used it was also possible to evaluate their relevance (defined as the resultant 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 sheets as well as multi-stage problem solving methods e.g. 8D, 5PPJ. However, not only the 8D method was considered to be relevant by the respondents, but also the cause-and-effect (Ishikawa) diagram (Figure 3).

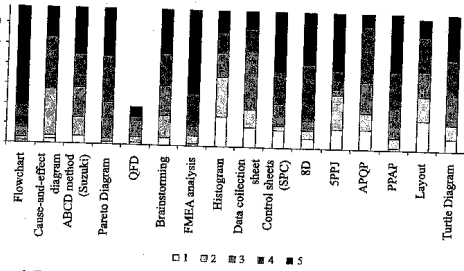


Figure 3. Evaluation of relevance of M&T in companies

Source: Own study based on questionnaire survey

The selected statistical population (suppliers certified for ISO/TS 16949 compliance) 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 QMS 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 (60%) admitted, though, that not seldom the requirement of using appropriate methods and techniques is fictitious, i.e. 8D reports, FMEA reports etc. were compiled 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 unequivocal factors, such as:

- the fact that such actions require much time (77.94%),
- insufficient staff (72.06%), and
- the fact that the employees are not sufficiently prepared to use them (72.06%) – Figure 4.

It must be pointed out that the respondents did not consider using M&T as unjustified or connected with significant financial expenses. It may be assumed that suppliers in the automotive industry are aware that such methods and techniques can be used effectively. What is more they feel the need to use them and even the lack of requirements related to their use does not contribute to the fact that such M&T are applied less frequently.

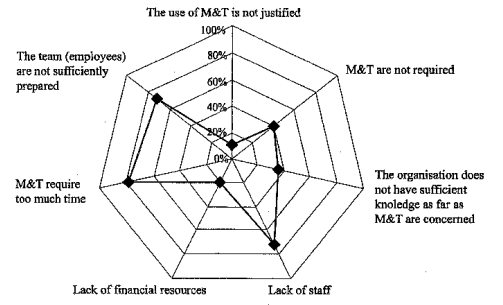


Figure 4. The causes of limited use of M&T in a company as a percentage

Source: Own study based on questionnaire survey

The results of self-evaluation concerning the knowledge of respondents (quality managers, quality department managers, proxies for quality) confirmed that limitations in the use of M&T exist. Generally, respondents evaluated their own knowledge as quite good (46%) – Figure 5.

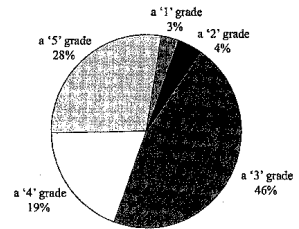


Figure 5. Self-evaluation of respondents concerning their knowledge about M&T ("1" indicated very poor knowledge and "5" – very good knowledge)

Source: Own study based on questionnaire survey

However, there were no randomly selected people in this group. All of them felt the need to educate and develop in that specific area of expertise.

### Conclusions

The author verified the common theoretical approach regarding the methods and techniques of quality management. The research also showed that companies in the automotive industry used in practice only a limited number of the huge number of tools described in literature. In addition to that, the results of the research helped to determine which methods and techniques were the most effective when it came to their use. This was of key relevance 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 direction their strategies for development and improvement of quality management systems should go in order to be effective. When the universal 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 organisations realising 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. flowcharts and FMEA, and moreover process monitoring tools (SPC) and problem solving methods – above all 8D.

### Acknowledgment

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### IDENTYFIKACJA I OCENA ISTOTNOŚCI METOD I TECHNIK ZARZĄDZANIA JAKOŚCIĄ NA PRZYKŁADZIE BRANŻY MOTORYZACYJNEJ. WYNIKI BADAŃ

**Streszczenie:** W latach 2009–2011 zostały przeprowadzone badania, których celem były identyfikacja oraz ocena istotności metod i technik zarządzania jakością stosowanych przez dostawców dla branży motoryzacyjnej. Przeprowadzono badanie przygotowawcze (metodą delficką), w gronie ekspertów – w celu zidentyfikowania i wyselekcjonowania metod i technik stosowanych przez dostawców na pierwszy montaż, oraz badanie właściwe (ankietowe) na pełnej populacji – we wszystkich przedsiębiorstwach certyfikowanych ISO/TS 16949.

W rezultacie pierwszego badania liczba stosowanych metod i technik zarządzania jakością została ograniczona do kilkunastu. Sześciu ekspertów z Polski oraz Stanów Zjednoczonych ograniczyło zestawienie metod do kilku, m.in. *flow chart*, Ishikawa Diagram, Pareto Diagram, FMEA, Turtle Diagram.

W wyniku badania właściwego dokonano weryfikacji wskazanych metod pod kątem powszechności ich stosowania oraz ważności. Najważniejsze i najskuteczniejsze okazały się FMEA, schemat blokowy oraz 8D.

Autor zweryfikował powszechne teoretyczne ujęcie dotyczące metod i technik zarządzania jakością, spośród bowiem bardzo wielu narzędzi opisywanych w literaturze, w praktyce