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SIGNIFICANCE OF QUALITY MANAGEMENT SYSTEM (ISO/TS 16949) FOR OE/OES SUPPLIERS IN THE AUTOMOTIVE INDUSTRY. RESEARCH RESULTS OF COMPANIES LOCATED IN POLAND

Introduction

Companies – OE/OES suppliers for automotive industry, supply components exclusively and directly to OEM; many companies cooperate with customers from other branches, including also cooperation under OE/OES contracts. In every day practice of quality assurance the fundamental question is that of significance of particular sets of requirement and of specific requirements. Evaluating the significance of QMS criteria can enable more efficient planning at the stage of implementing, maintaining and developing management systems. An effective QMS in this case means a QMS which enhances gaining and maintaining the statute of OE/OES supplier for automotive industry. A research question defined in such a way has a very pragmatic dimension, because of a significant number of criteria automotive industry suppliers have to meet. In most cases, an OEM customer presents a substantial set of additional requirements on quality management, i.e. CSR* – customer specific requirements.

Research objectives

The target research problem has been formulated in the question about the significance (defined as importance, not statistical validity) of particular quality

* Selected customer specific requirements: Quality Cap Suppliers (Audi), Supplied Parts Quality Mgmt (BMW), TS 16949:2002 Customer Specific Requirements (DaimlerChrysler), Honda Supplier Quality Manual (Honda), SMITQA-003 (Mitsubishi), Supplier Quality Manual (Firestone), General Motors Customer Specifics – ISO/ TS 16949 (General Motors), Suppliers Manual (Weweler).

management system requirements. This question is significant when we think about the substantial number of requirements and 'good practices' in the field of quality management in the automotive branch [3].

To realise the research objective it was necessary to perform the following tasks:

- identifying the criteria, which do not have a formal expression, but make up criteria in the QMS – very often in the form of solutions typical of the branch, or branch know-how,
- evaluating the significance of these requirements on a sample of companies which have undergone comprehensive assessment – including both the point of view of certification bodies, or customers and requirements according to which own projects are carried out – aimed at evaluating the efficiency and effectiveness of management systems,
- interpreting key requirements in a quality management system which has to be taken into consideration and developed to gain and maintain the status of certified supplier of OE/OES in the automotive industry.

Finally, a practical objective complemented the research objective. That practical objective was to prepare a list of most crucial requirements as far as QMS were concerned for the said suppliers on the basis of audit criteria significance and conclusions drawn based on them.

Thus, in practice the basis of QMS is the ability of an organisation to prepare collective and interdisciplinary flow diagrams, PFMEA, control plans as well as safeguarding their consequent resultant relation.

Review of literature in this field indicates that research question defined in such a way has not been investigated earlier. The significance of requirements in QMS has not been analysed. Neither have been some practical questions concerning the direction of maintaining and developing systems to ensure effective and efficient functioning on the market. Research has been made as far as key factors in TQM are concerned [2, 5, 10] and there are many publications concerning selected aspects of Quality Management Systems – materials of theoretical and practical (research) character and case studies [1, 4, 11, 12].

Requirements set in the automotive industry concerning OE/OES suppliers

When we take into consideration the practical operation of OE/OES suppliers a number of different requirements can be indicated. These include the following:

- standards which are the basis of QMS certification – first of all ISO/TS 16949:2002 (but also VDA 6.1 and other standards),
- legal regulations; related to human rights protection in particular,
- environmental management and environmental protection, patent rights and intellectual property protection,

- rules on performing production process audits as well as product audits, required in ISO/TS 16949, but described in VDA 6.3 and VDA 6.5,
- key tools in systems of the automotive branch – described in QS-9000 manual – advanced product quality planning (APQP), production part approval process (PPAP), statistical process control, measurement system analysis (MSA), failure mode and effect analysis (FMEA) [6],
- Interpretation of ISO/ TS 16949:2002 requirements and certification rules (Automotive Certification Scheme for ISO/ TS 16949:2002, Rules for achieving IATF recognition, 2nd edition for ISO/TS 16949:2002, as of July 8th 2004) determined by International Automotive Task Force (IATF),
- and finally customer specific requirements (CSR).

Supplier quality management system in the automotive branch is shaped above all by customers who determine the requirements for quality management. Customers can either be car manufacturers or 1th tier or 2nd tier suppliers. At the same time, the criteria are defined by certification bodies, which are supervised by the accreditation authority International Automotive Task Force (IATF) [9].

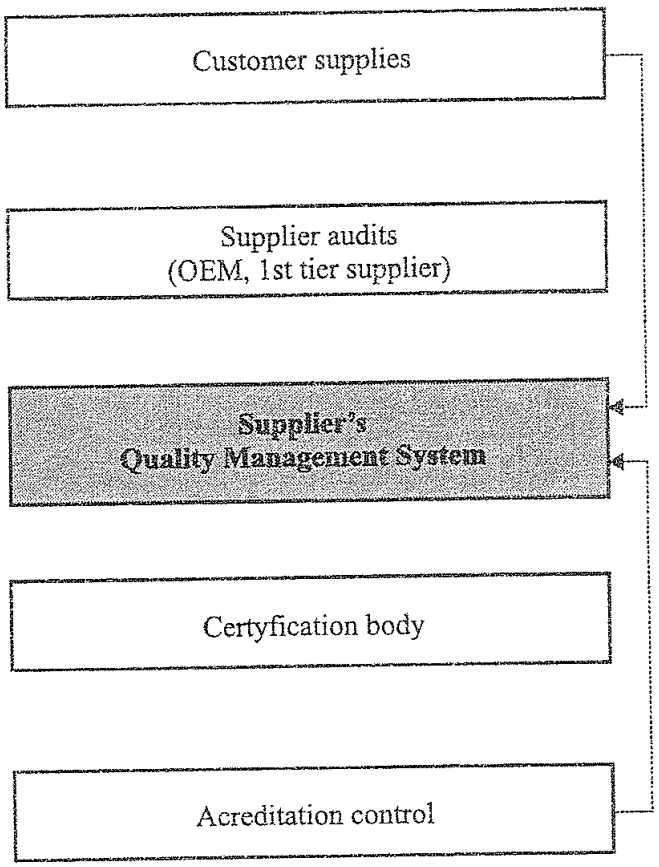

Figure 1. Shaping supplier QMS by direct and indirect influence of external units

Customer specific requirements (CSR) play a special role here, as they are determined by almost every customer in the branch – always by car manufacturers and manufacturers of other vehicles and very often by 1th tier

suppliers to 2nd tier suppliers. Such requirements usually take the form of formal documents which most often are interpretation or extension (sometimes very extensive) of requirements of the base standard for QMS (ISO/ TS 16949:2002).

Scope, subject and object of the research

In order to realise research objectives and verify formulated research hypotheses a preliminary (S1) and proper (S2) study were first designed and then performed. The main point of interest of the author in the research was the criteria on which quality management systems which were implemented, maintained and developed by automotive branch OE/OES suppliers are based on. The two studies were designed to evaluate the requirements of quality management system for the suppliers in the automotive industry.

Preliminary study conditioned performing proper study and supplementary research as it was designed to identify requirements (criteria) related to quality management which suppliers had to meet. As a result of preliminary study a questionnaire was compiled. The questionnaire was the tool for proper study and supplementary studies.

Table 1. Characteristics of performed research

No	Objective of the study	Study population	Sample size/responsiveness	Study method	Tool	Data collection method
B1	Determining a set of requirements (criteria) of supplier QMS for in the automotive industry. Drawing up a questionnaire form – a tool for proper study and supplementary studies	Focus group: Top management and quality managers of 1st tier suppliers of OE/OES equipment	8/not applicable	Delphi method	Updated versions of checklist	the Internet, telecon-ferences, meetings, videocon-ferences
B2	Evaluating the significance of particular requirements (criteria) of supplier QMS for in the automotive industry	Companies with quality management systems certified against ISO/TS 16949:2000 headquartered in Poland	180/ 39%	Categorised questionnaire form	Questionnaire form	the Internet

Research was carried out according to determined schedule; in case of the preliminary study, it was the third and fourth quarter of year 2004. The proper study was performed in the 3rd and 4th quarter of 2005 and in the 1st, 2nd and 3rd quarter of 2006.

Proper study was performed on a population of homogenous character – as far as quality management is concerned. These organisations were awarded an ISO/TS 16949 compliance certificate which was tantamount to cooperation with customers under OE/OES contracts. On one hand, these companies (successfully) underwent certification audit performed by an accredited certification body. On the other hand, they have cooperated with at least one customer under OE/OES contract.

To present how the studies were conducted, synthetic data is presented in Table 1. The objective of the study was determined, as well as the study population/group, sample size, responsiveness, research method, research tools and data collection methods.

Proper study (S2)

Proper study description

The proper study was carried out to evaluate the significance of quality management system requirements for suppliers in the automotive branch. The study was carried out on a group of companies headquartered in Poland and certified against ISO/TS 16949 requirements. The study was performed on whole population; gained responsiveness was equal to 39% and other statistical parameters enabled inference for the whole study group.

To verify the obtained results in each and every case the following indicators were calculated: arithmetic mean, modal, median, coefficient of variation, Pearson's correlation coefficient and Spearman's rank correlation coefficient.

The study was carried out as a questionnaire form and the data obtained was analysed and subject to statistical inference to verify the hypotheses formulated in this research work.

Study methods and data collection techniques

The objective of the conducted study was to evaluate the significance of audit criteria for quality management system.

The subject matter of the research is ISO/TS 16949 compliance certified companies – 1st tier OE/OES equipment suppliers for OEM. The subject matter is quality management systems, audit criteria in particular – requirements which are set for system requirements.

A questionnaire form was used to conduct the research. It was distributed by electronic way (by means of e-mail) and was specially fitted for the means of internet study [7, 8].

To complete the base of respondents – companies which certified against ISO/TS 16949 requirements – a multi stage process based on one basic source of data and completion of databases was performed. The basis to determine the general population was a list of certified companies supplied by IATF. The author verified the list and complemented the database based on the following sources:

- certification units operating in Poland,
- consulting units providing consulting and training services on quality management in the automotive branch,
- national register of companies holding certified management systems run by Department of Industrial Policy of the Ministry of Economy in the Promocja Jakości (Quality Promotion) programme,
- data obtained from Automotive Market Research Institute SAMAR,
- data obtained from the Polish Chamber of Automotive Industry.

Study group description

Proper study was carried out on all companies located in Poland which at the time of the research had ISO/TS 16949 compliance certificates (companies with Conformance of applicability status were not included in the group of companies participating in the research). The general population amounted to 180 companies. 70 properly completed questionnaire forms were returned. Then, the questionnaires were analysed and inference was based on them.

Holding a certificate by the respondent was a sufficient and at the same time best criterion as it was tantamount to:

- the company meeting ISO/TS 16949 requirements, i.e. a specific and most common standard, dedicated for the automotive industry,
- the respondent having been subject to audit performed by auditors representing a certification unit, accredited by IATF,
- the organisation rendering services as OE/OES equipment supplier for customers in the automotive industry who determine their own customer specific requirements (CSR); and providing services for at least one such customer, cooperating with car manufacturers of first tier suppliers (possibly second tier suppliers) or such companies being 1st and 2nd tier suppliers for OEM vehicle manufacturers.

Automotive industry supplier requirements significance evaluation

The most important study results are related to QMS criteria significance evaluation, irrespective of the category, or subcategory they were assigned to (the

Table 2. Significance of QMS requirements (average marks) – proper study (S2)

Requirements	Average mark	Median	Modal	Gap	Coefficient of variation (%)
FMEA – control plans	9,19	9	10	5	11,80
PPAP – production plan approval process	8,86	9	9	5	12,46
Control plans	8,81	9	10	4	12,44
Customer-designated special characteristics	8,61	9	10	6	19,11
8D	8,56	9	9	7	18,05
Quality management system	8,44	9	9	6	17,37
APQP – advanced product quality planning	8,36	9	8	8	21,49
Determination of requirements related to the product	8,33	9	9	7	17,30
Preventive actions	8,31	9	9	7	22,82
Review of requirements related to the - product (organization manufacturing feasibility)	8,25	9	10	6	17,36
Team work (problem solving methods and techniques)	8,23	9	9	8	25,10
Communication with customer	8,14	9	10	7	20,33
Control of nonconforming product (income patibility suspicion, control of reworked product, customer waiver)	8,13	8	9	6	19,10
Team work	8,09	8	8	7	20,78
Corrective actions	8,09	9	9	4	15,99
Acceptance criteria	8,08	9	9	7	22,84
Manufacturing process improvement	7,91	8	9	9	26,84
Monitoring and measurement of product	7,90	8	8	7	21,43
Maintenance. Preventive and predictive maintenance	7,86	8	8	7	21,88
Monitoring and measurement of processes	7,85	8	8	8	24,76
Cleanliness of the premises	7,81	8	9	8	22,40
Process management (COM, MOP, etc.)	7,78	8	9	7	24,13
SPC (identification of statistical tools, knowledge of basic statistical concepts)	7,66	8	8	6	21,12
Audit of the production process	7,56	8	8	8	27,86
Plant, facility and equipment planning	7,55	8	7	9	27,46
Customer satisfaction study	7,55	8	9	8	24,22

cd. table 2

Requirements	Average mark	Median	Modal	Gap	Coefficient of variation (%)
Supplier qualification and continual supplier monitoring (supplier quality management system development)	7,46	8	8	7	28,81
Responsibility, authority and communication (responsibility for quality)	7,41	8	8	9	27,20
Audit of the quality management system	7,40	8	8	7	24,32
Management representative (customer representative)	7,39	8	8	7	23,13
Identification and traceability	7,37	8	7	8	26,44
Continual improvement of the organization	7,36	8	9	9	27,16
Production scheduling	7,34	8	9	8	25,64
Customer focus	7,32	8	8	8	28,51
Audit of the product	7,23	7	9	7	22,05
Planning (quality objectives, business objectives correlation)	7,21	8	8	8	31,26
Contingency plans	7,19	7	7	7	25,86
Training courses (position trainings, in taking back to customer's requirements)	7,18	8	8	8	30,02
Information security	7,05	8	7	9	35,99
Validation of production process and service provision	7,05	8	8	9	29,35
Storage and reserves	6,95	7	7	9	32,52
Data analysis (analysis and use of data on the company level)	6,95	7	7	7	27,14
Internal communication	6,91	7	8	7	29,73
Measurement system analysis	6,89	7	8	8	28,91
Employee motivation and empowerment	6,84	7	8	8	29,23
Staff competence	6,83	7	8	8	27,82
Verification of purchased product (incoming product quality)	6,71	8	8	9	37,84
Control of records (customer records retention)	6,69	7	8	8	27,58
Work instructions	6,68	7	8	9	31,71
Regulatory conformity	6,55	7	7	9	39,15
5S	6,54	6	9	7	41,27
Management review	6,54	7	7	9	28,07

cd. table 2

Requirements	Average mark	Median	Modal	Gap	Coefficient of variation (%)
Confidentiality	6,52	7	8	9	35,43
Management commitment (process effectiveness)	6,80	6	5	6	25,39
Personnel safety	6,48	7	8	8	33,23
Quality policy	6,43	7	8	7	30,45
Change control	6,37	6	5	8	35,85
Preservation of products	6,34	7	5	8	24,46
Quality costs	6,32	9	9	8	43,18
Management of production tooling	6,28	7	8	9	38,91
Control of documents (engineering specifications)	6,18	6	7	9	28,91
Quality Manual	6,18	7	7	9	30,32
Completeness of required documentation	6,09	6	7	8	25,72
Risk management	6,02	6	4	8	47,30
Customer-owned production tooling	5,89	7	2	9	46,84
Verification of set-ups	5,85	6	6	8	32,46
Benchmarking	5,73	7	9	9	57,47
Feedback of information from service	5,68	6	3	9	57,74
Customer-approved sources	5,64	7	8	9	56,75
Customer property (raw materials, resources, production in progress)	5,55	6	9	9	61,81
Configuration management	5,07	5	4	9	45,33
External laboratory	5,05	5	1	9	65,05
Internal laboratory	5,00	6	2	8	50,63
Calibration records	4,82	5	3	9	48,12

following article does not present study results in relation to category, subcategory and range of requirements). According to the respondents the most important QMS requirements are:

- relation between FMEA and control plans,
- production part approval process (PPAP),
- control plans,
- customer-designated special characteristics,
- 8D reports [6],
- quality management systems,
- advanced product quality planning (APQP),

- determination of requirements related to the product,
- preventive actions,
- product requirement review,
- team work.

The top ten requirements reflect the specificity of quality management in the automotive branch. Requirements which are not typical of ISO 9001 but specific for supplier management systems in the automotive branch are dominant here. This confirms also that the choice of study objective was right and that its results may be of importance to companies planning expansion on OEM customers. Within these systems stress must be put on components which were unknown to many companies, even if they held ISO 9001 certificates.

Among the first ten criteria considered to be most significant both PPAP and APQP and their key elements, i.e. control plans, FMEA, specific characteristics, and team work were indicated. Coefficient of variation for all requirements considered to be of importance is in the range from 0% to 35% which suggests small dispersion, and the arithmetic mean characterises the average level of significance value in a proper way.

Summary

Based on the study results inference was performed in relation to formulated study hypotheses. It can be concluded that:

- ISO/TS certificate is a requisite element; it does not guarantee, however, cooperation with customers under OE/OES contracts,
- the most important QMS system requirement are customer specific requirements and not requirements of the standard which is basis for certification (ISO/TS 16949),
- any QMS should be based on advanced product quality planning (APQP) and production part approval process (PPAP),
- other significant requirements are most often components of APQP and PPAP, or are strictly related to them; i.e. control plans, FMEA, specific characteristics, team work,
- for QMS it most important to ensure resulting relationship in control plans related to risk assessment results from FMEA results, compiled earlier based on previously designed production processes (presented in the form of flow diagrams),
- communication with the customer and the ability to solve problems, especially 8D also turned out to be very important.

It is possible to determine the priorities in shaping QMS based on the results of the study and the conclusions. They indicate that the key requirements are branch specific. This in turn necessitates the use of branch specific vocabulary

by the personnel, knowledge of procedures and using them in practice. Apart from that knowledge of branch specific methodologies is also crucial. We cannot conclude that there are universal experts on quality management. In this case general knowledge is not sufficient. Key requirements QMS have to meet are not present in quality management systems based on ISO 9001. Similarly, specific components are essential to branch management systems, e.g. in the food, pharmaceutical, aviation, armaments or IT industry.

Respondents regarded the relation between FMEA and control plans to be crucial. Control plans are compiled as result of preceding process (PFMEA) or design (DFMEA) risk assessment. That is why this relation is so significant to the respondents. In every case, these requirements should be treated in direct relation. In other words FMEA should not be performed, and control plans should not be designed and practiced independently. However, mistakes in this respect are common practice. They may be committed consciously and deliberately or unconsciously, as the requirement are not understood properly. Thus, maintaining direct relation between the designed process, risk assessment results using FMEA and process supervision solutions reflecting the identified risks.

A quality management system is a necessary condition for the supplier to cooperate with customers (OEM, 1st tier suppliers) to whom OE/OES equipment is delivered. However the following system should not be understood and implemented as a collection of independent conditions, which are independent answers to the requirements. A QMS has to take account of priority requirements and mutual relations between particular solutions.

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OCENA ISTOTNOŚCI WYMAGAŃ (ISO/ TS 16949) SYSTEMU ZARZĄDZANIA JAKOŚCIĄ DOSTAWCÓW BRANŻY MOTORYZACYJNEJ. WYNIKI DLA DOSTAWCÓW NA PIERWSZY MONTAŻ W POLSCE

Streszczenie

Niniejszy artykuł prezentuje metodykę badań oraz wyniki badań podjętych dla oceny istotności wymagań systemu zarządzania jakością dostawców branży motoryzacyjnej. Dla realizacji celów badawczych przeprowadzono badanie wstępne (S1; metoda Delficka) poprzedzające badanie właściwe (S2, wywiad kwestionariuszowy skategoryzowany). Badanie wstępne zostało przeprowadzone w gronie ekspertów (z Polski, Czech oraz Stanów Zjednoczonych). Badanie właściwe zostało zrealizowane pośród wszystkich dostawców na pierwszy montaż w Polsce, mających certyfikowane SZJ ISO/ TS 16949. Wyniki badań są ważne dla wszystkich przedsiębiorstw w branży motoryzacyjnej tak dla obecnych dostawców, jak też przedsiębiorstw planujących uzyskać status dostawców na pierwszy montaż. Analizy oparte na niniejszych wynikach powinny właściwie ukierunkować projektowanie, utrzymanie i rozwój SZJ.