RESULTS FROM A CASE STUDY OF ISO TS 16949 IMPLEMENTATION

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The aim of the paper is to investigate the results of ISO TS 16949 implementation and the steps used by an autoparts company to obtain its certification. A case study was adopted as a research strategy by collecting data from interviews, obbservation of the work environment and analysis of documentation. The results obtained from the study revealed that during the preparation for certification, the company's organizing framework helped obtain ISO TS 16949 certification, because its implementation steps were able to identify all the necessary work, the allocate resources to execute this work and to plan the auditing in order to achieve its objectives.

Palavras-chaves: quality system, quality management, ISO TS 16949, certification

1. Introduction

Transformations in ways of producing industrial products have collaborated to a large extent to developing the concept of quality management, starting from the era of production inspection towards the era of quality control up to that of total quality management (HOERL, 1998). Alongside the evolution of ways of production, from mass production to the Toyota system and the need for quality assurance, standards for the automotive sector have been created which use the ISO 9000 series as their basic model. In terms of evolution, it can be cited documents developed by the automotive sector in the 1990s: EAQF *(Evaluation d'Aptitude à la Qualité pour les Fournisseurs)* from the French assembly plants, VDA6 *(Verbrand der Automobilindustrie e.V.)* from the German assemblers and QS 9000 (1994) developed by the three large American assemblers, Chrysler, Ford and General Motors (JOHNSON, 2004). QS 9000 (1994) was the sole normative standard for the suppliers for the companies that developed this set of requirements. Its third edition was launched in March 1998, and included aspects of the European standards with the goal of greater integration with them. Meanwhile, QS 9000 had not been formulated by the International Organization for Standardization - ISO and therefore there was no standard specified by ISO. This is the reason that a document that met the ISO as well as the assemblers' standards was needed. To integrate all these standards of the automotive market (including the Japanese), and obtain a document in line with international standards and to avoid multiple certification audits, the technical specification ISO TS 16949 came into being in 1999 and is not in its third edition launched in 2004.

ISO TS 16949 (2004) is a technical specification specifically destined for use in the automotive industry. This specification is based on the ISO 9001 (2000) standard whose goal is to develop quality system management, which leads to continuous improvement, emphasising the prevention of defects and the reduction of variations and losses in the supply chain. This specification also avoids multiple certification audits, and provides a common approach to the quality management system for the automotive sector, centred in management by process. Currently, there are 35,198 certificates world-wide in 81 countries from which 972 are from companies in Brazil (ISO, 2007), where the investigated company is located.

Adopting this international technical specification is important because companies that supply products to automotive manufacturers have to be certified (LUPO, 2002). In this context, this paper investigates the results of implementing the ISO TS 16949 in an autoparts company. The theoretical reference used to reach the proposed objective is presented, followed by the methods and techniques adopted for the study, the results of implementing the ISO TS 16949 and finally, the study's conclusions.

2. Theoretical background

The complexity observed is the result of interdependence among the diverse parts of an organization (MULEJ, 2004). This complexity and these interactions make the search for a solution to problems go beyond understanding any problem in particular to the need for a holistic understanding, viewing the problem from a broader perspective.

Certain techniques are used in isolation to resolve these organizational problems. Because the companies are inserted in a broader context, they are used to simplify the organization schematic and thus make it possible to do a case study of one of the parts of the organization along with its outside environment (MAXIMILIANO, 2002). However, one cannot

understand a company or organization without first taking the measure of its various, interrelated, and interdependent parts. Studying the interdependence of the overall is the basis of systematic thought. Differently than the traditional analysis by separation, systematic thinking, works by understanding the interactions of the subject studied with the rest of the system that comprises it (ARONSON, 2006). The interactions existing inside the company or organization take place because they are considered as systems; a system is a set of parts ordered and integrated toward an objective.

These elements have relationship and interactions among themselves. Interaction is the mutual influence of inter related organisms that exercise shared activities, and there are reciprocal exchanges and influences. Thus, the functioning of a system depends on each of the parts and not just one of them. Thus, the system is more than the sum of its parts; it is the product of their interactions.

The interactions of the part of a system occur due to their organization, i.e., their structure. Structure is understood to be the organization and ordering of the essential elements that make up the system. The essential elements are (MOIGNE, 1994): the inputs, processes and outputs. The inputs are the resources, whether physical or abstract, which the system receives from the environment to assure its functioning. The processes interconnect the resources utilised in the input and transform them into results, i.e., the outputs of a system.

An organization can be understood as a system, subsystem or supersystem (CHIAVENATO, 2000). The system autonomy can be greater than that of the subsytem and lesser than the supersystem. When a certain system interacts with the supersystem or with the subsystem, that is around it, it is classified as an open system. Open systems are those that interact with their environments and with other systems around them (CONTI, 2001). When viewed as systems organizations are influenced by their environment in which they act and in turn, influence this environment; thus they are classified as open systems. Examples of systems within the organization can be seen in Figure 1.

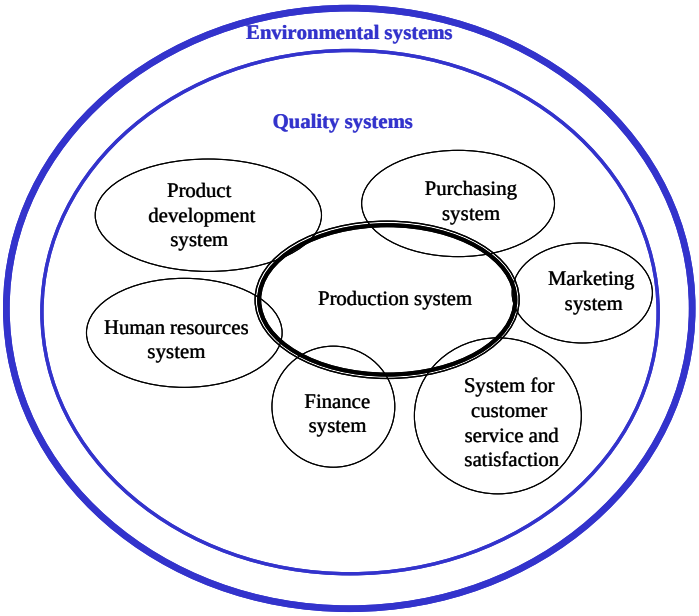

Figure 1 – Relationship among the various systems of an organization (adapted from SLACK et al., 2002).

2.1 The Quality Systems

The concept of system is also applied to quality systems. Thus, a quality system can be conceptualised as a set of processes that function harmoniously using various resources to achieve objectives related to quality, and these are focussed on meeting customer needs and expectations (KARAPETROVIC and WILLBORN, 1998). According to these authors, the main input to the quality system is customer needs. After being identified, they must be transformed into feasible goals. The authors name this process "quality planning," which is a fundamental part of the quality system. Thus, "quality planning" is a subsystem of the quality system and is illustrated in Figure 2.

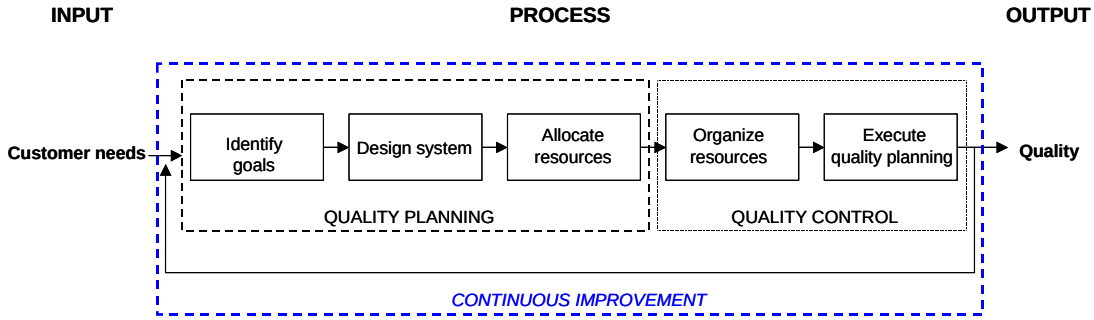

Figure 2 – Quality system and subsystems (adapted from KARAPETROVIC and WILLBORN, 1998).

After planning for quality, it is necessary to organize resources and execute the plan. These two activities comprise quality control which is another subsystem within the quality system, whose inputs are the outputs from the "quality planning" subsystem and whose outputs are product quality (Figure 2). To check the efficiency of the system, the "quality" output is compared with customer requirements input into the quality system. When the quality system output does not meet requirement, the result is a defective products. When the output meets requirements, there is an effective result. Therefore, when the output has a better result than customer requirements, the quality or continuous improvement system is surpassed; the process of continuous improvement, quality planning and quality control are processes that make up "quality management" (KARAPETROVIC and WILLBORN, 1998).

Quality management can only be observed in an organization that has a quality management system. The ISO TC 16949 technical specification was created to aid in developing this management system. It includes the following highlights.

2.2 ISO TS 16949 outline

The ISO TS 16949 technical specification is a document prepared by the International Automotive Task Force (IATF) and by the Japan Automobile Manufactures Association Inc. (JAMA). The main characteristic of this type of technical specification document is that it requires fewer approvals and has fewer steps in its development than an international standard (IS –International Standardization), which is a document with a defined life of three years after publication. When this period ends, it will either be revised or it will lapse. The specification was born of the need for the existence of a sole document inside the ISO. Thus, in 1999 the ISO TS 16949 was first published, it underwent a revision in 2002 based on the ISO 9000 standards (2000). There was a new revision of the technical specifications in 2004 supported in ISO 9000 (2000). The main objective of ISO TS 16949 is to develop a global

management system that stresses loss reduction inside the supply chain by means of specifying the requirements for a quality system (KATHA, 2004).

3. Research methods

The case study is a research strategy whose purpose is to investigate certain unknown situations or that those that need to be better understood (CERVO and BERVIAN, 2002). This methodological approach permits an investigation in which the significant facts of real life events are preserved (YIN, 1994). They are recommended when the questions to be answered by the study are of the "how" and "why" type and when the researcher has little control over the events studied. Thus, there is an attempt to answer the following questions in the present study: how was ISO TS 16949 (2004) implemented in the company studied? What are the results of its implementation? The question to be answered in a case study also determines the kind of research to be done, i.e., the study is outlined according to the goals for the case study, which can be exploratory, descriptive or explanatory (VOSS et al., 2002). Research of the explanatory type is concerned with identifying the factors that determine the occurrence of certain factors studied, deepening knowledge of the reality beyond the appearance of its phenomena, while the exploratory type tries to inform the researcher of the real importance of a problem when there is little knowledge of it (CERVO and BERVIAN, 2002). In the present study the work is of an exploratory-descriptive nature, which tries to describe certain phenomena, in this case about the implementation of ISO TS 16040, as well as being exploratory since there is a lack of work on this theme. Thus, the main goal of this type of investigation is to become familiar with the phenomenon studied, to acquire new perceptions and discover new ideas (CERVO and BERVIAN, 2002).

The research uses several sources of information, such as document analysis, observation and interviews by the researcher. This kind of information characterise exploratory research and can be obtained from case studies, whether multiple or single case studies may be adopted (the latter is adopted by the present work). In terms of the selections of this case, the rationale of the present work has to do with cases considered typical or representative of the auto parts sector, whose market is an oligopoly. Nonetheless, it can be considered a typical company since it has particular features which mark the oligopolistic group and there are only about four companies in the autoparts sector that have those same characteristics.

Figure 3 presents a three-phase research plan to be used once the strategy and methodology have been identified: 1) Definition and planning: the theoretical framework is developed based on bibliographic review, and the case to be studied is chosen; the data collection tools are defined and the type of data to be used is determined; 2) Preparation and analysis: consists of carrying out the case study itself. For the study in question, document analysis observations of the work environment at the unit of analysis and interviews were used. The interviews are carried out with people in different hierarchical positions (workers, quality analysts, process engineering and production managers; 3) conclusion: summary of the work carried out and the results.

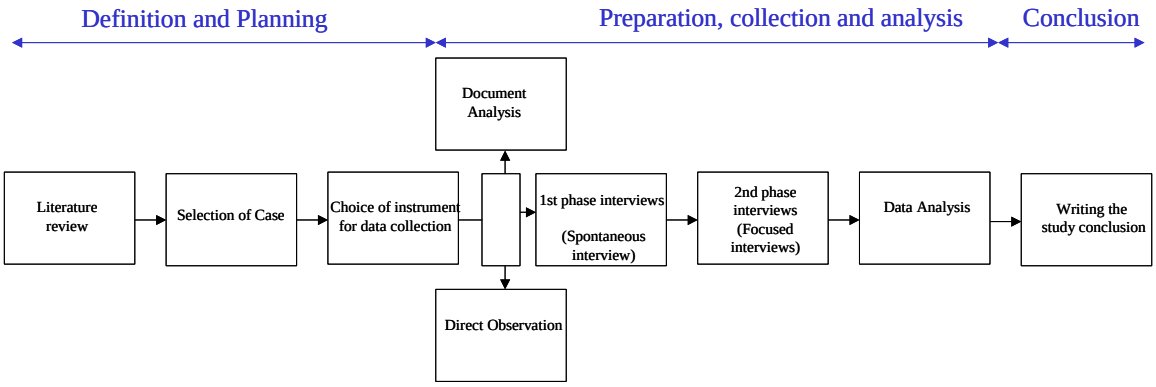

Figure 3 – Stages of the research plan (adapted from YIN, 1994).

Following is a description of some of the sources of information that were used in the first stage of this project, i.e., planning. Two types of interviews were carried out – spontaneous and focused. Spontaneous interviews were conducted informally with the researcher asking questions and the respondents giving their opinion on certain subjects while focused interviews are carried out in an informal manner, however they do follow a set of questions and the duration of the interview is established before hand (YIN, 1994). This type of interview is used when one wants only to confirm previously gathered information.

The spontaneous interviews, whose purpose was to understand important aspects of the implementation of ISO TS 16949 (2004), were carried out during the first phase. Each interview lasted approximately 60 minutes and the respondent could register an opinion about each of the questions. During the second phase, focused interviews were done with the same respondents, since they were available and wanted to collaborate with the research. The goal was to confirm some of the information collected during the first phase of interviewing. The focused interviews lasted about forty minutes. Information was recorded by hand in a 12-page research log for both types of interviews, since recordings were not authorised by the company. Information was later analysed based on these registers.

There was an observed lack of precision in some answers given during the interviews, due to gaps in the respondents' memories, as the literature predicted (YIN, 1994). Documents such as monthly reports of waste indicators (rejects) were then consulted to obtain more precise answers and, in some case, to corroborate such answers.

Another source of information was document analysis, which involves documents which have not been treated analytically, including administrative documents (internal procedures), minutes from meetings and others. The usefulness of this type of document is not in the precision of information that they provide, but rather in the performance of their main function which is to confirm and validate information taken from other sources (YIN, 1994). One type of document used is the monthly performance indicator report, which is used to confirm the data cited during the interviews.

The methodological approach for the work has been established. The following section presents the first results.

4. Background of the implementation

The company studied is a multinational which is present in over 20 countries, employing about 90,000 people world-wide. It employs 4,000 people in Brazil and has annual revenue of US$ 1.5 billion. The unit studied is located in the state of São Paulo and produces about 13

million products annually, of which 44% is destined to the aftersales market, 27% to original equipment manufacturers (OEM) and 29% to the export market.

The expansion at the Brazil plant was encouraged due to the company's history with respect to its quality program which has introduced the following initiatives: In 1984, a statistical control process (CEP) was implemented and in 1989 the company started *Kaizen.* Following the expansion of the company's quality program in 1990, it introduced TQC (Total Quality Control). In 1994, the company was certified for ISO 9001 and in 1998 as QS 9000. Later, it sought certification according to ISO TS 16949 in its 2002 version, which it obtained in 2003. While the company received ISO TS 164949 certification in 2003, preparatory work for certification began a year earlier. The company's preparation time for QS 9000 certification was longer, lasting a year and a half. The company adopted the same strategy that it used for QS 9000 certification for ISO TS 16949 certification.

The strategy was initiated with an earlier survey of the work that would be needed for the transition from QS 9000 to ISO TS 16949. This survey was done by a group of internal auditors. Once the amount of work was determined, upper management opted not to contract a consultant to help with the preparations, but did choose some collaborator who would join the work teams and dedicate 30% of their time (approximately 10 hours per week) to activities related to preparing for certification. Five work teams were established so that each could take on an item for ISO TS 16949 in order to study it and determine the work necessary for certification, establish a timeframe for the execution of each step in the work and carry it out in the time planned. Each work team would have a leader whose responsibility was to monitor the required tasks in a schedule to complete them in a specified time.

The teams were made up of eight members from different areas and functions (i.e, multifunctional teams). Each function for a work team is related to an item of the standard the team is working on. The organizational chart in Figure 4 shows the make up of the teams responsible for item 7 "Realizing the product" of ISO TS 16949 (2004). Thus, it is necessary for people from the development, production process and sales areas to be involved, since this team deals with everything from customer needs, translating them into the product and process design, up to the internal controls for the process needed to produce a given product. The same procedure is used for each item of the standard and for each work team.

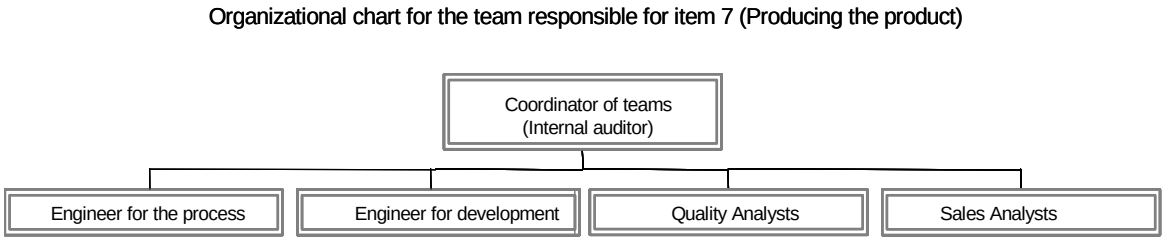

Figure 4 – Example of an organizational chart for a work team.

The functions and responsibilities on the work team are the same for each member, i.e. the items were divided among the team members and each was responsible for one item. Execution is to be understood as involvement with other persons, requesting some work necessary for the finalisation of the items they are responsible for, raising resources and requesting treatment, etc.

The teams meet at least once a week for 45 minutes, and a total of 48 meetings were held over a 9-month period, in order to check the completion of the previously identified, recorded

items, monitored by means of schedules. Attendance by team members and meeting dates were controlled by the team coordinator monthly and a report was issued to all company managers indicating the percent attendance and the percentage of completion of the items by each member. This fact was confirmed during the interviews to motivate the team work. Despite control over attendance (reports filed with the quality department) and completing the items, minutes were not taken and that prevented our monitoring and checking their content.

Teams were coordinated by internal auditors, one of whom was responsible for two teams and another for three. The auditors were responsible for guiding the team work and assuring that the schedule was maintained. They reported to the company's quality manager who was responsible for overall coordination of the preparatory work for certification, as well as making the connections between the work teams and upper management, capturing financial resources for items such as training when necessary.

After setting up the structure it is necessary to prepare the work teams for work. All team members took a 16 hour training program administered by an outside consultant. The content was to learn the items in the technical specification; the differences between ISO TS 16949 (2004) and QS 9000 (1998) and the emphasis given to ISO TS 16949 (2004) in utilising the approach to processes. The content of the training was developed by one of the company's quality managers together with consultants. There were two types of training for employees. The first one is directed at the work teams and was administered by consultants as mentioned earlier; the second is for company employees who are not part of the work teams and is administered by employees who are members of the teams. Thus, the teams are trained first by the outside consultant and later these teams train the rest of the company.

The content, structure and schedules for training the work teams and other company employees were different. While the work teams received complete information on items in the ISO TS 16949 the differences between ISO TS1949 (2004) and QS 9000 (1998), and other information as mentioned above; the rest of the employees learned of the need for a transition between QS 9000 (1998) and ISO TS 16959 (2004), the concepts of ISO TS 16949 (2004) and the control plan in training meetings. The teams also received information about the strategy for preparing the company for transition, including the training for the work teams. The training meetings occurred three months before the date set for the certification audit.

To structure the training meetings, the quality manager with support from employees from the human resources (HR) department, develops a communications plan involving around 1,600 people including those with administrative and worker-level positions.

The communication plan set the number, date and schedules for training meetings, the names of those responsible for administering the meetings and the predicted termination date. This communication took place all through the 66 training meetings, structured to last an hour and with 25 participants.

After carrying out the training, the work teams programmed an activity for all the employees, called "involvement by chain" because the work teams met with each company supervisor, and the content was disseminated via a company bulletin. Each supervisor then met with their subordinates and passed on the information the work team had shared. The purpose was to communicate the date of the certification audit, since it had been set after the training was over and there had been no opportunity to communicate it at the time. The expectations of each employee in order to pass certification were stressed during this activity.

Once the teams were set up the work methodology and employee training had been established, it was necessary to unite all the activities that had to be carried out so that the company qualifies for ISO TS 16949 certification (2004). Figure 5 shows the schedule that contains the complete strategy for the preparatory tasks for ISO TS 16949 certification (2004), running form the creation of subjects, training, carrying out tasks common to all the teams, the internal audits, correction of non-conformities to arrive finally at the certification audit. Two audits took place: an internal audit (item 11 in the timetable in Figure 5) and a pre-evaluation carried out by the certifying agency (item 15 in the timetable in Figure 5), and in the 12th month of the schedule obtain ISO TS1 6949 certification. The results of the implementation are presented in the next section.

5. Results

Implementation of the technical specification brought benefits to the company studied that were mentioned during the interview and later were verified as described as follows. ISO TS 16949 (2004) meant standardising position descriptions including the competencies needed for each position. This facilitated the changes in position and functions, making them easier. Taking the team leader as an example, training was based on technical knowledge the operators need to carry out their functions. After implementing ISO TS 1949 (2004), the standards for training changed. The competencies needed for the functions and the training manual were reformulated, including treatments that reinforce these competencies and for the function in example, situational leadership was included. People are better prepared to exercise their functions and develop the competencies needed for this function.

Improved quality of the final product is measured by a performance measure called “Customer satisfaction indicator” is measured in ppm (parts per million) of products. The average for the six months prior to ISO TS 16949 (2004) certification was 96, while the average for the six months after certification was 92, as can be seen in Figure 6.

Work phases	Responsible	month 1	month 2	month 3	month 4	month 5	month 6	month 7	month 8	month 9	month 10	month 11	month 12	month 13
1 – Analysis of the differences between ISO TS 16949 (2004) and QS 9000 (1998)	Internal audits	→												
2 – Training work teams	Quality manager		→											
3- Determine amount of work necessary for the transition	Internal audits			→	→									
4 - Doing training on ISO TS 16949 (2004) for members of the work teams	Quality manager			→	→									
5 - Division of responsibilities for doing the tasks by the work teams according to items on the ISO TS 16949 (2004)	Internal audits					→								
6 - Check and fit all quality procedures to the ISO TS 16949 (2004)	All work teams						→	→	→					
7 – Assessment and writing new quality policies	Quality manager						→	→						
8 - Evaluate the quality manual	Internal audits						→	→						
9 - Developing communications plan for implementation of the ISO TS 16949 (2004) for the employees who are not part of the work teams	Quality manager						→	→						
10 - Realization of the communication plan for implementation of ISO TS 16949 (2004	Quality manager							→	→	→	→			
11- Internal audit to prepare for certification	Internal audits										→	→		
12 - Evaluation and correction of non-conformities	All work teams											→		
13 - Pre-evaluation by the certifying agency	Lloyds Register												→	
14 – Involvement in the chain for auditing ISO TS 16949 (2004)	Team supervisors												→	
15 – Evaluation of the qualifications by certifying agency	Lloyds Register													→

Figure 5 – Timetable for preparatory activities for ISO TS 16949 certification.

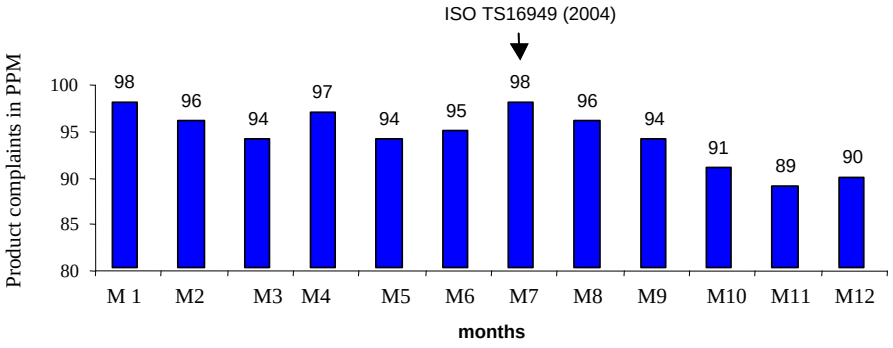

Figure 6 – Customer satisfaction performance measure (‘year 5’; see Figure 7).

Figure 7 shows the levels of loss in a certain sector of the company. These levels are presented in percentage values of total annual production. Therefore, the lower the percentage, the less loss is generated. The observed tendency up to ‘year 3’ was variable. As the certification starting in ‘year 5’, this performance measure improved from year to year. All those interviewed mentioned that a tangible benefit of implementing the technical specification was a drop in the loss levels as illustrated in Figure 7.

Nevertheless, it is necessary to consider another aspect that can influence the indicators in Figure 7 during the transition from ‘year 6’ to year 7’: the US $ 900,000 investment in technology to improve the condition of the machinery which consequently affected the quality of production. In ‘year 4’ and ‘year 5’ there were no investments, while in ‘year 6’, the value

invested was 15% higher compared to 'year 2' and 'year 3'. There was no investment in 'year 7'. In 'year 4' and 'year 5' there were no investments and the ISO TS 16949 (2004) certification was obtained in 'year 6'. Referring to the graph for monthly losses, shown in Figure 8, during 'year 5', one can better verity the influence of the certification on this performance measure.

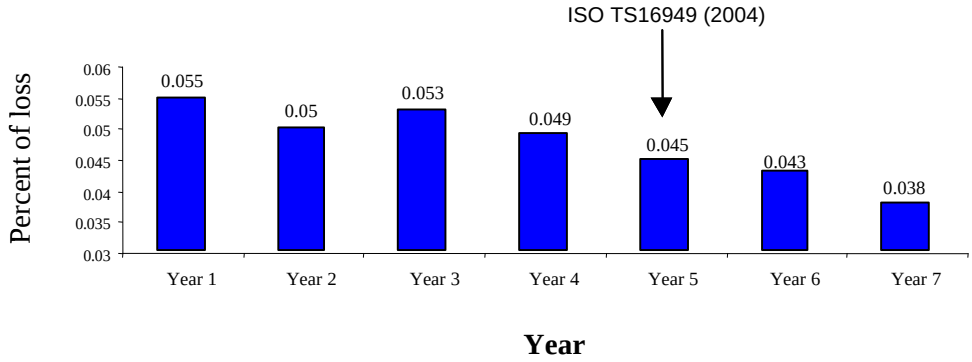

Figure 7 – Loss indicators for Sector 1.

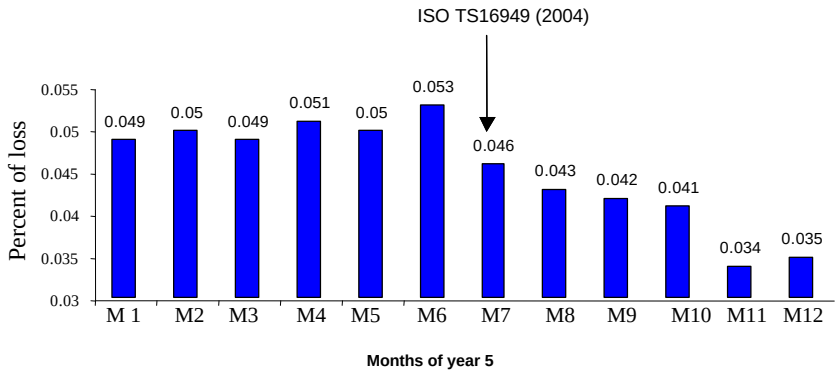

Figure 8 – Loss indicators for Sector 1.

Figure 9 shows the result of a productivity measure related to the quantity produced and the total labour utilised (person-hours used). This amount is compared to a standard amount which is corporative. This figure is compared to a standard value, which is defined by the company headquarters. The amounts observed in Figure 9 are considered to be excellence figures within the corporation (the corporative goal is 95.5%), which indicates that this indicator shows higher amounts and that the annual differences (for example from 'year 5" to 'year 6') are considered to be small. For this reason, the influence of ISO TS 16949 (2004) cannot be shown in this measure, but it is stressed that the company has a good performance within the corporation, as also confirmed by internal company documents. One important indicator to be shown could be the measures of the process capacity (Cp and CPk). However, the company did not authorise disclosure of these figures.

Figure 10 shows a graph with a measure called the "apparent quality index for the product." This measure indicates the percentage of products considered to have excellent apparent quality, i.e. of the total products inspected in 'year 7', for instance (93.8%) were considered to have excellent apparent quality. The remaining percentage was not necessarily rejected (scrap), but was classified by means of visual inspection that disqualified products as 'excellent'. Excellent products are those that have a nearly perfect appearance, with no evident defects. Figure 10 shows an improvement in the measure between 'year 5' and 'year 6'. The company had established a goal of 93.2% for 'year 6' and reached 93.5%. This

occurred due to the inclusion of this measure as a benchmark in the control plan (as illustrated in Figure 11) after the implementation of ISO TS 16949 (2004). However, although the company had a control plan, this parameter had not been considered a special characteristic. According to the technical specification, every special characteristic, i.e. the product features which are essential for its safe and appropriate use should be identified in documents such as the FMEA and the work specification and all the stages of the process that affect these characteristics can also be identified.

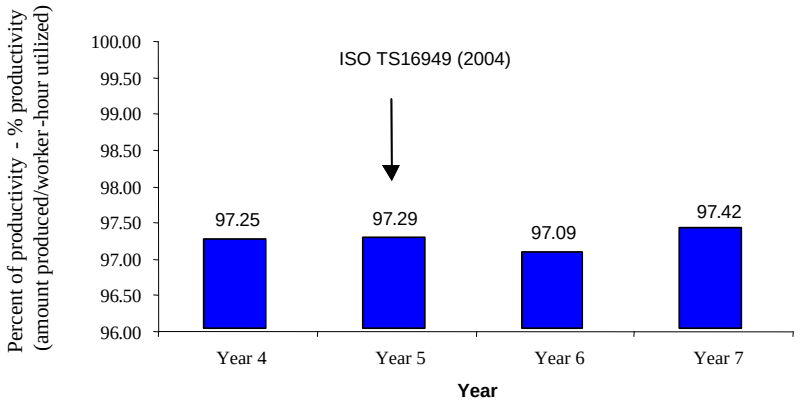

Figure 9 – Productivity indicators from sector 1.

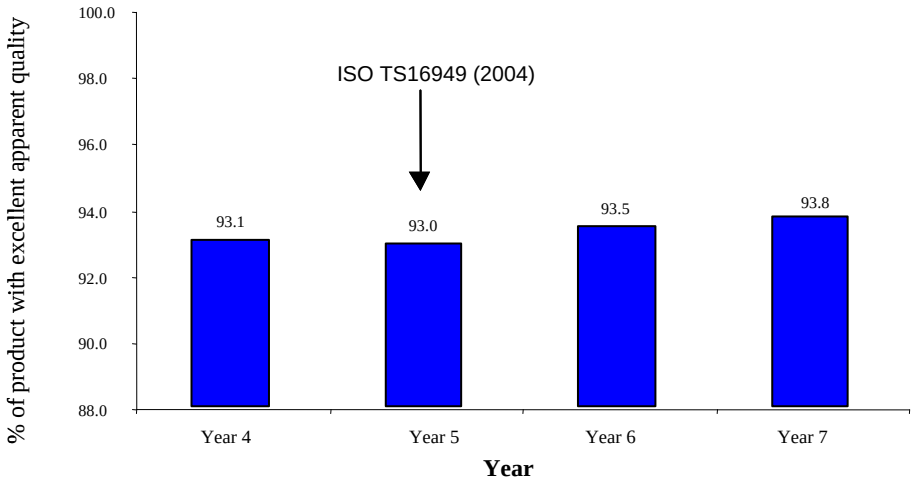

Figure 10 – Measure of apparent product quality.

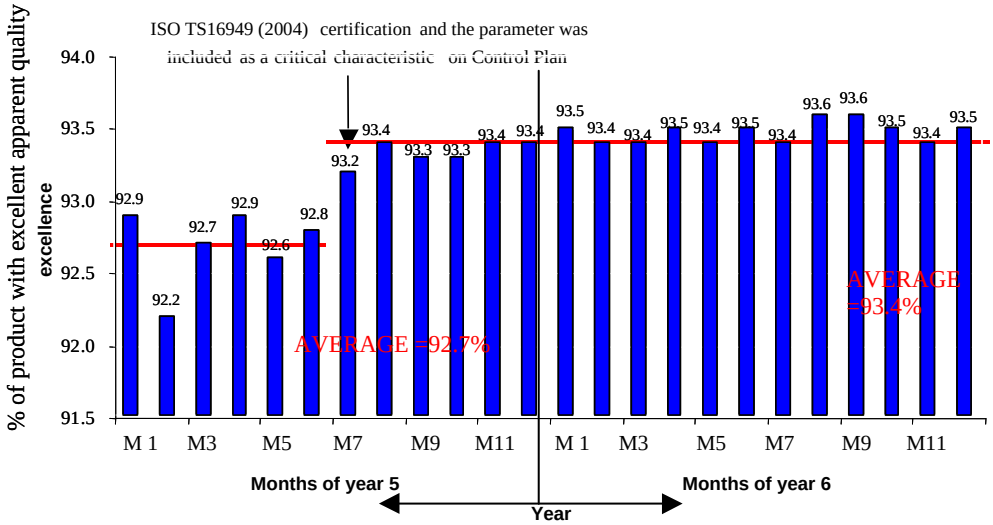

Figure 11 – Quality indicator for products during part of 'year 2' to 'year 3' (aggregated values is in Figure 10).

It was observed that although all those interviewed could identify the benefits resulting from implementing ISO TS 16949, no one could say what the variation in these measures was before and after implementation of ISO TS 16949. This was verified and demonstrated in the records of the measures. After presenting the result of the implementation of ISO TS 16949, the conclusions of the work are outlined.

6. Conclusions

The study showed that the organization of the company during the preparatory process for certification made it easier to obtain certification since it adopted a strategy capable of identifying all the work required allocated resources to carry out the tasks and planned the preliminary audits needed to identify and correct possible faults and obtain ISO TS 16949 certification. It was observed that implementing ISO TS 16949 brought tangible benefits to the company as can be observed in the measures presented in this work. Thus, it can be concluded that the process of implementing ISO TS 16949 was structured in an organised manner, and had positive repercussions on the company. Moreover, the goal of the present work, to investigate the results of implementing ISO TS 16949 in an auto parts company, was also achieved, from which the results of this implementation was presented.

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