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Application of the Three Realities Approach to Customer Complaints Analysis in the Motorcycles Industry

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Abstract

This work main objective is to adapt and apply the three realities approach (*Gemba*, *Genbutsu*, and *Genjitsu*) to the analysis of field quality problems in a motorcycle industry and gain advantage with regard to the quality of the product on the market (quality management) and transfer to partners financial responsibilities regarding the origins of these problems (management of warranty costs). The three realities approach and other quality methodologies adapted for this work are presented. After the characterization of the context of the case study, a plan for implementation is defined. Based on the plan, development work focused primarily on obtaining the results of the parts analysis (*Genbutsu*) and *in loco* analysis (*Gemba*). The latter is crucial to determine the process to deal with the responsibilities of costs and quality field problems. After the plan implementation, the results obtained are assessed, particularly regarding the management of warranty costs, which are reduced one third, through the provision of responsibilities between suppliers and internal sectors of the company. Similarly, quality management is evaluated through the results of the *in loco* processes analysis (*Gemba*), culminating with the results of decision-making (*Genjitsu*) for corrective actions, improvement and containment, as well as, the determination of its cost/benefit.

Keywords: Customer complaints; product quality; *Gemba*, *Genbutsu*, *Genjitsu*; product liability; warranty costs.

1 Introduction

After its design, an industrial product evolves through different stages until reaching the stage saturation and decline. However, to reach this stage, a product undergoes transformations as problems arise that have not been evidenced in the stage of development and approval. These problems may be caused by failures in project development, by defects in manufacturing or by customer conditions of use different from those provided for in design phase. The Product Engineering "team" should analyse and propose amendments on the basis of the problems highlighted to new models, and for existing projects and processes. However this may not happen, especially in large companies. According to (Womack *et al.*, 1990), the coordination between the sales divisions and the product designers in big companies of mass production is, in fact, unsatisfactory. At the beginning phase of product development there is discussion on customers product acceptance, but afterwards, there is lack of feedback from the sales divisions, dealers and even between manufacturers and other departments involved with information on product quality (such as defects, appearance requirements and functionality) demanded by customers (Womack *et al.*, 1990).

The inclusion of information of customer product performance in the Product Engineering team may allow significant improvements in reliability and, consequently, reduce the inherent costs of failures during the phase of product operation and maintenance. In addition, this reliability improvement will reduce the number of failures and associated costs in the warranty period. It will also cause an increase in customer satisfaction. Quality, cost and speed in the solutions offered are the main determinants of tangible value to the customer (May, 2007).

This paper presents the main results of a master thesis in Industrial Engineering (Soares, 2011).

2 Literature Review

Taiichi Ohno was the Toyota executive largely responsible for structuring and implementing the system known today as the Toyota Production System. Ohno (1988) was known for drawing a circle around managers and making them stand in the circle until they had seen and documented all of the problems in a particular area. For example, in the middle of a congested production area, managers should observe the process and question why ("5 whys") for each fact, with the aim of obtaining a real understanding of the process (*Gemba*). Allegedly, within the first hour of observation they begin to understand the process, in the second hour see the problems, in the third hour ask the "whys" and, in the fourth hour, discover the root cause and plan the counter-measures.

On the basis of this learning technique emerged in Toyota and other companies methodologies that employ these principles of observation and analysis to develop the manager a critical thinking through the understanding of reality. Among these methodologies a particular emphasis is put in this paper to the three realities approach.

2.1 Three Realities Approach

The three realities (3G's) approach is a method of problems analysis and solutions which collects factual evidence from the reality of defective products, the process that led to the failure, and finally, relates these evidences to set up acceptable conclusions, consistent with the facts, and propose realistic and achievable counter-measures. This approach enhances and standardise the observation putting managers in contact with real facts, customers, employees, processes, products, inspections, etc., stressing the importance of having the manager in contact with real "things" (*Genbutsu*), "places" (*Gemba*) and "situations" (*Genjitsu*). Information and graphics are important to make decisions, but managers who have experience with the reality of observed facts that make the right decisions (Liker and Meier, 2006).

This approach appears framed on the management principles of the Toyota Production System (TPS) that suggest how the combination of philosophy, processes and people towards problem solving can create a learning culture. Some of these principles are summarized:

- Method of the Five Whys: consists in questioning facts and explore the cause and effect relationships between variables with the objective of eliminating the root cause of problems.
- *Genbutsu*: Based on *Genchi Genbutsu* approach, Liker (2005) established the Principle 12 of the Model Toyota as "see for yourself to fully understand the situation", that is, it is the observation of in loco facts and the understanding of the realities that leads to failure mechanisms.
- *Gemba* is a term that means "true place". In the Toyota Model, the first step in the process of solving problems is "go to the *Gemba*". What we see at first hand does not appear in reports (Liker, 2005).
- Decision-making (Consensus): usually, in companies, each area meets and deals just with a given subject (design, manufacture, purchase etc.). This way, consensus decisions are hindered, since each team is not trying to reach a common objective for the organisation as a whole. The decision-making by consensus involving different areas is a learning tool.
- Telling the story in a Report: the report must have a logical flow and contain the minimum information which appears on the definition of the problem, an explanation of the causes, the plan of implementation of counter-measures and ways of monitoring the results. A source standardized and searchable information on problems analysis can be built with the objective of knowledge transfer and to build failure prevention mechanisms.

2.2 Other Approaches

The product field quality can be measured through the systematic collection of customers complaints related to functional failures or appearance that make the product inoperable in some function or undesirable by the customer. These failures may be related to the manufacture or with the design, both the responsibility of the manufacturer. To deal in a systematic way with this market information related to the quality is necessary to adopt procedures and methodologies especially developed for this purpose.

Quality Function Deployment

Quality Function Deployment (QFD) (Akao, 1990) is a systematic approach especially suitable for design and development of products or services. It is carried out by multidisciplinary teams which reflect the needs and requirements of the client in technical specifications of the project and in actions relevant to each stage of the production process. The strength of the QFD is to make explicit the relations between customer requirements and characteristics of the product and the parameters of the production process, cost and reliability, allowing the harmonisation and prioritization of various decisions taken during the development process of the product, and to enhance team work. In the latter aspect (team work), and the members of the team develop a common understanding of the decisions, their reasons and their implications, and in this way, they become committed to the initiatives for the implementation of the decisions that are taken collectively.

Customer complaints analyses are essential to improve design and quality of products and to correct deficiencies in existing products. This quality improvement in new products is based on previous similar models. The complaints and suggestions (feedback from the client) provide information relevant to improvement proposals.

The use of QFD adds several benefits, such as: focus on customers' demands and complaints in product development; considers the strengths and weaknesses of the competition to improve or change the product; records structured historical information; reduces costs with internal and external failures, because they are corrected during development; helps in decision-making; and the members of the organization produce justify decisions.

Six Sigma

The main objective of the Six Sigma methodology is the achievement of financial advantage and competitive in a planned manner. The focus is to manage and monitor processes with the aim of reducing or eliminating errors that cause defects.

For this methodology, quality is the result of a broad effort of the organization to achieve the goals identified in company's strategy (Boarin, 2006). The strategy considers the nature of the business, the size, its specific characteristics and the cultural and social aspects for those who participate in and are identified the differences between customers' requirements and system's capacity (Blauth, 2003). The costs reduction through quality and process improvement lead to profitability increase by means of defects reduction, rework costs, warranty costs, customer satisfaction increase, brand prestige, among other intrinsic factors (Antony and Banuelas, 2002).

FMEA

Failure mode and effect analysis (FMEA) is a technique used to identify, prioritize, and eliminate potential system, design or process failures before they reach the customer. This technique is usually performed during the conceptual and initial design phases of the system in order to assure that all potential failure modes have been considered and the proper provisions have been made to eliminate these failures. FMEA is a widely used reliability analysis technique in the initial stages of product/system development.

A FMEA provides a detailed insight on inter-relationships of the system and aspects which boost the failures. In many products or systems, the failures of some of its components can cause safety risks. The responsibility for the evaluation of likely failures that occur during use (phase of the operation and maintenance) by customers is from the manufacturer. The correction and mitigation of such potential failures are usually based on the ranking of the severity and probability of failure. Typically for each mode of failure is established a risk indicator - RPN (Risk Priority Number) which is the result of the product of three basic indicators: the frequency of occurrence (P); the probability that the defect will be detected (D);

and the severity of failure mode (S), and are listed the possible actions to correct the failure and restore the function or prevent serious consequences.

The collection of information about similar projects earlier from internal and external sources including data from FRACAS (Failure Reporting, Analysis and Corrective Action System), interviews with designers, staff of the operations and maintenance, component suppliers, customers, etc., are fundamental to the construction of FMEAs.

Finally, it is important to note that the assessment of priorities for failures correction and/or mitigation is a subjective criterion for each company that should determine their levels, according to the characteristics of the product its objectives, quality policies and strategies.

3 Case Study

3.1 Organisation

The case study is an industrial company that assembles motorcycles, particularly, the unit of analysis is its Field Warranty Sector (FWS). When a warranty claim is filled by a costumer, through a concessionaire, a flow of data and, eventually, parts is initiated. There is a procedure to deal with such customer complaints and some samples are selected for detailed analysis. The FWS communicates with the after-sales service (SPV) that represents the client and dealers, the various productive sectors, and suppliers of the company, solving field quality problems and providing feedback to the after-sales service. Further details on this case study are found in Soares (2011).

The main input of the FWS is the Quality Improvement Correspondence (QIC). This is issued by the SPV in standardized form, relating to one or more customer complaints from a specific problem. The QIC is a request for problem analysis.

A process for problem analysis consists of the following stages:

1. Problem Definition;
2. Root Cause Analysis, countermeasures and monitoring;
3. Action in the field.

The result of the analysis, and transferred to a report in A4 format (horizontal), called Quality Information Sheet (QIS). This emphasizes the main points recorded since the definition of the problem until the implementation of actions with their dates of application and responsible. Afterwards, this information is introduced in the system of digital information is supplied to the SPV for assistance and guidance in the event of similar complaints. The monitoring of actions' effectiveness is performed by SPV.

The customers of the FWS are:

- SPV (responsible for the management of quality in the field);
- Concessionaire/Technical, Assistance/Dealer (indirectly the results of the analyzes provide feedback and guidance to the dealers on the problem analyzed);
- End Users (are indirect customers);
- The Sector or supplier responsible for the cause of the problem;
- Final Inspection of the Assembler (receives information about the problems).

The FWS may be accessed through a set of existing performance indicators:

- Warranty index (percentage value per month): ratio between field complaints frequency and the sales volume. This index is stratified by item;
- Deadlines: Analyses have deadline for completion;
- Responsibility definition: deficient specification (SPECIFIC), internal Sections (FAB), Suppliers (FORN DE), After-Sales Service (SERV), User (USUA), and impossible to define cause (IMP DEF).

3.2 Problem definition

The defects (or field quality problems) presented by the product in the period of 1 year after sale related to problems in manufacturing, design and packaging are the responsibility of the company. The warranty index average, last year, was 9%. There are, on average, 10,000 warranty claims per month, with an average monthly cost of $1 million dollars in parts and in replacement services. These values are associated with an average production volume of 120,000 units/month (96.5 % of which are sold in the Brazilian domestic market). Each motorcycle has between 1,000 and 1,500 components. The costs of each warranty claim vary significantly depending on the problem. The company has suppliers in Brazil and in other countries such as Japan, Thailand, China, Indonesia, Italy, as well as, various internal sections of Manaus plant.

The field quality problems are analyzed through the QIC, but, it may not contain a reliable description.

The costs associated with warranties are added to the manufacturing cost of the finished product. The imputed value on each unit is obtained through the ratio between the monthly warranty cost and production volume. The average cost per product for the last year was around US$ 8 dollars, representing almost 1% of the direct costs of manufacture. These costs are not passed on to the suppliers. The QIC analysis does not guarantee that a representative sample of each problem to be extensively analysed and thus it is not accepted by suppliers.

It was collected a sample of parts on the 2942 warranty cases recorded in the month of March 2011, which represents approximately 38% of the total number of cases. The items were collected from 482 dealers (out of approximately 750 scattered throughout Brazil).

4 Implementation

The main objective of this work is to adapt and apply the "three realities approach: *Gemba*, *Genbutsu* and *Genjitsu*" in the analysis of field quality problems.

4.1 Analysis of parts (*Genbutsu*)

The objective of the parts analysis is to define the problem responsible, to associate the parts with the existing reports (QIC/QIS) and to efficiently identify new problems focussing on the defect characteristics and symptoms. It must be possible to define the problem and the place where it occurs (*Gemba*) using a logical sequence for analysis. The problem root cause will point out to the responsible (supply, domestic sector, user, technical assistance, etc.). The sample was distributed in four groups of analysis: Engine, Finished product, Resistance and Electric. This division was based on different constructive characteristics of the motorcycle, to allow the presence in each group analysis, technical experts in their respective areas. Table 1 show the stratification obtained through the parts analysis.

The results of all the analysis of were transcribed in a standardised form. Table 2 shows the results of parts analysis revealing that 15.1% are new problems, and in 8.9% it was not possible to identify responsibility.

Table 1: Stratification method for characterization of problems

ANALYSIS OF PARTS (GENBUTSU)	GROUP OF ANALYSIS				TOTAL	
METHODS OF ANALYSIS	ENGINE	M. COMPLETE	RESISTANCE	ELECTRICAL		
VISUAL	491	340	66	195	1092	37.1%
DIMENSIONAL	320	28	2	0	350	11.9%
FUNCIONAL TEST	141	57	236	555	989	33.6%
ANALYSIS OF THE MATERIAL	250	24	2	235	511	17.4%
TOTAL CASES	1202	449	306	985	2942	100%

Table 2: Stratification by generic classification

STRATIFICATION	ENGINE	M. COMPLETE	RESISTANCE	ELECTRICAL	**TOTAL**	
EXISTANT ANALYSIS (QIS)	589	251	246	471	1557	52.9%
NOT POSSIBLE TO DEFINE RESP.	126	100	6	31	263	8.9%
NEW PROBLEM	216	63	17	149	445	15.1%
BAD USE/FAILURE OF MAINTENANCE	271	35	37	334	677	23.0%
TOTAL CASES ANALYSED	1202	449	306	985	2942	100%

4.2 Judging problem relevance

The relevance of each problem was evaluated with focus on customer impact, its frequency and detection mechanism. The repercussion on the client and evaluated on the basis of the symptom claimed and tests performed during parts analysis.

The problems were judged in meetings, attended by the analysts of the FWS, Final Inspection and Sector of New Projects, with the following results:

- Impact on the Customer: the problems were classified into four categories (customer safety risk, violation of the legislation, functional or visual problem);
- Frequency in the Field: the frequency of problems was evaluated; and
- Detection mechanism: 103 new problems were evaluated as to the existence of internal control mechanisms capable of containing the problem.

4.3 Analysis in loco (*Gemba*)

The objective of the *in loco* analysis is to clarify the causes of the problem. An *in loco* examination will occur whenever the problem is new. The *Gemba* is a thorough analysis of the place where the problem occurs, in order to correlate observed facts, collected data and evidence found in parts analysis. The analysis was performed *in situ* to 76 problems: 22 plant internal sections, 13 suppliers in Manaus, 22 suppliers in Sao Paulo, 6 international suppliers and 13 in Product Engineering of the (problems with design specifications). The problems were analysed as below:

- Processes Analysis: 40 out of 76 problems had a history of failure. Current Process does not assure required quality: Procedures and standards were not defined; procedures and standards were not being met. The factors that justify the root cause for 27 problems were not found;
- Correlation of facts/evidence: Of the 40 problems with historical, 10 problems presented direct relationship with the analysed problem (4 related to technical problems, 3 had no procedure defined and 3 the procedure was not being followed). 49 problems were passed on to stage of correlation and were analyzed in relation to technical issues and management issues;
- Simulation tests: in 16 problems the failure mechanisms were not present in the processes that and were submitted to further tests in order to simulate the causes and reproduce the same effects found in *Genbutsu*:
    - 14 problems had their mechanisms of cause and effect reproduced (6 problems related with technical issues and 8 problems related with management issues);
    - 2 problems did not have their mechanisms of cause and effect reproduced.

4.4 Decision Making (*Genjitsu*)

The decision-making based on real causes and the countermeasures to be applied depends on data collected during the analyses, mainly the pieces (*Genbutsu*) and processes (*Gemba*). It was evaluated the feasibility of actions regarding the cost, quality, productivity and safety. The decisions are shared in consensus with the involved so that all are responsible for the success of the solution.

The decision-making on the causes and responsibilities were firmed in meetings (some used video conference), involving the respective responsible for analysis, monitoring and solution:

- Definition of causes: on the basis of the information collected in the phases of parts analysis (*Genbutsu*) and *in situ* analysis (*Gemba*) and in agreement with the respective involved, decisions were taken on the root causes;
- Definition of countermeasures: similarly, countermeasures were agreed; causes at the origin in 28 of the 47 problems were eliminated; improvement actions were applied and monitored.

4.5 Feedback for new models

The provision of feedback for new models has the objective to benefit from field information and technical analysis to assist new product development. The proposal has included the Sector of New Projects as a customer of the FWS. The proposals were decided in consensus with the FWS, Supplier Responsible for the problem, Final Inspection and Sector of New Projects.

It was added to the QIS a field with a simple description of the proposed amendment. In the future, before starting the development of the new model, this information will be used. This feedback information included the 47 problems that had their causes clarified:

- Project Evaluation: 47 problems were evaluated in terms of the criticality of technical characteristics of design specification, which are incompatible with some customer use modes;
- Process Evaluation: 26 problems were evaluated as to the criticality of technical characteristics of the manufacture processes. 3 problems originated feedback for new models.

The proposals were made in consensus with all those involved, and simple descriptions feasible for implementation were presented. The proposals will be for designers/engineers evaluate and transform in technical characteristics of new projects. This allowed discussing the possibility of improvements that previously were not perceived by engineers/designers due to the specific characteristics of customer use and processes related to manufacturing and logistics.

Figure 1 presents the new flow of information for warranty claims based on the improvements described in this section.

5 Verification and Control

This section presents the implementation results, adjustments considered necessary, as a result of stratification of the causes and the result of the distribution of warranty costs to those responsible.

5.1 Data summary of the implementation results

A summary of the results of the activities developed in the implementation of the improvement actions defined in the previous section is presented:

- the parts analysis (*Genbutsu*) related to the stratification of problem and cost resulted in total warranty costs in the period of US$ 940,047.45;
- 153 New problems were verified through 445 occurrences;
- The relevance of 153 problems regarding customer impact was evaluated. It was found that in 76 of them it was necessary to carry out an in loco analysis (*Gemba*/process related to the problem): (1 safety risk, 17 legislation violations, 32 high frequency (>0.04%) and 26 without any internal detection mechanism;
- The result of the in loco analysis (*Gemba*) of 76 problems with the decision-making (*Genjitsu*) and feedback for new models was:
    - problems were caused by technical (22) and management (27) issues;
    - in loco analysis allowed explaining the causes of 47 problems;
    - 2 technical problems and 1 management issue provided information for new product development.

Flow of Information Processing of Quality on the Market (Plan)

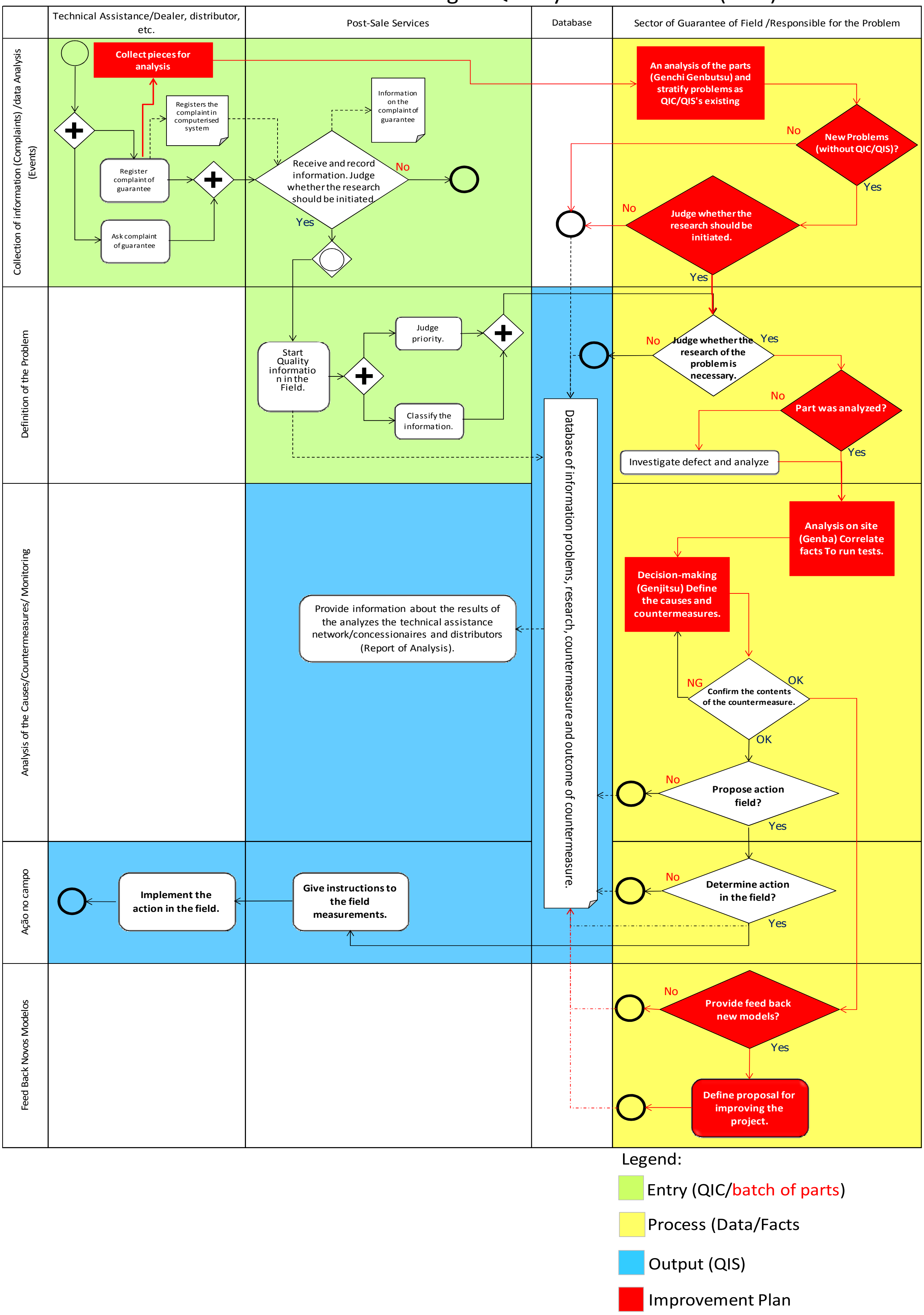

Figure 1: New Flow of Information for Warranty Claims

5.2 Criterion to define a representative sampling

Some adjustments were required to pass the costs to suppliers. It was defined by consensus, between internal sections/supplier and the FWS the following rule: the sample size to be analysed, from each type of problem, must be at least 2 and it should be always higher than 20% of the number of warranties per problem. This criterion reduced the level of representativeness of analysed problems from 90% to 65%.

5.3 Difficulties

This topic presents some difficulties regarding the analysis and implementation of the approach:

Supply contracts permit for the passing of the warranty costs, but do not specify how to do it. The focus of the work was to develop a method accepted by the partners to pass these responsibilities.

There was some resistance on the acceptance of responsibility costs for 27 problems that had not their causes characterised with *in loco* analysis (*Gemba*) and also for 77 problems which have not met the relevance criteria to be analysed in *Gemba*. However, it would be impossible to perform *Gemba* to all the problems within the available time. It was clarified that the objective of the *in loco* analysis was not related to warranty costs stratification (this would be achieved through stratified parts analysis - *Genbutsu*), but to identify and eliminate the causes by reducing the occurrence rates and improving the product field quality.

The items that, after the tests (*Genbutsu*), did not show the claimed problem were classified as concessionaire failure, because it was considered wrong diagnosis, having as responsible the After-sales service. This service was also considered responsible for the cases classified as "bad use". The after-sales service should set out directives to reduce/eliminate undue warranty payment related to concessionaries wrong diagnosis and improve guidance to clients on the use of the product in abnormal conditions.

In some cases it was not possible to define the responsible or root causes of the problem.

5.4 End result of responsibilities stratification (cost and quality)

It was possible to define the problems and their respective responsible for 66% of the warranty cases in the period through the representativeness of the analysed sample. It was also possible, to pass on 76% of the warranty costs in the period.

In short, from the US$ 940,047.45 in warranty costs that represent 7666 cases (field occurrences), US$ 717,011.01 were stratified and defined responsibilities representing 5048 cases. The general warranty index was 6.4 % for the month of March 2011. This reduction tendency increased resulting in reducing this index, over 6 months, from 9% to 6%.

6 Conclusions

A pilot project was developed and implemented that used the three realities approach of, *Genbutsu* (analysis of parts of field occurrences), *Gemba* (analysis of processes where these failures do occur) and *Genjitsu* (decision-making based on facts, where the impact of corrective/improvement actions is analysed) as a method to improve the process for handling complaints.

The presented technical analysis improved the product quality management and enables to pass responsibilities of warranty costs to the organization’s partners (suppliers and internal sections). As a result of the improvement actions the warranty index reduced from 9% to 6%.

Despite the literature on the 3Gs is not rich, "14 Management Principles from the World's Greatest Manufacturer" and "The Toyota Way Fieldbook" contributed significantly to this work mainly the *Genchi Genbutsu* Method used by the Toyota Production System. The FMEA method for the prioritization of failures contributed to define a procedure to judge the problem relevance and the QFD method was adapted to the 3Gs methodology, revealing how customer complaints, can be transferred to new products development.

The work involved partners in Japan, China, Thailand, local suppliers, assembly lines of the assembler and the FWS (including logistics) and finally, after-sales service of the Assembler and the network of authorized dealers. Everyone contributed significantly in their respective fields with efforts that have made this work possible. There was also, the consolidation work of financial and legal sectors of the assembler to enable the pass of financial responsibility, as well as the support of the board concerned and committed to the harmonisation of this type of management.

In this case study the proposed methodology to manage customer complaints allowed passing responsibilities to organisation's partners, used customer information to enhance new product development, and improved the overall warranty costs. It is believed that it is possible to implement this approach in other companies, through the study of each reality, mainly in automakers, which also need to manage quality of the final product through the supply chain as it was performed in this work. Future work could assess whether the methodology is applicable in other sectors.

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