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COST OF LOW-QUALITY

Abstract: *For the success of any company it is of at most importance to continuously improve the quality of its products. The high reliability, quality and functionality of BMW vehicles impress not only customers of the company but the independent juries and professional journalists are also praising the driving pleasure that BMW products provide. But how the costs of low quality can be measured? What potentials and measures can influence on the costs of low quality? How can those costs be reduced without negatively impacting quality? In fact, what are the costs of low quality?*

Keywords: *low quality, BMW vehicles, directs costs of low quality, indirect costs of low quality*

1. INTRODUCTION

There are numerous positive assessments in highly developed countries which promote development of the most successful companies, those who drive economic growth and development of the country and region in which they are located.

In terms of **GDP** (*Gross Domestic Product*) the German economy is the biggest in Europe and the fourth biggest in the world [1].

Almost all areas of Germany have some industry. The province of Bavaria is not only an internationally attractive production location, but also one of the leaders in quality worldwide. The best-known industry, with a turnover of 357 billion euros in 2012, is automotive manufacturing [2]. Such companies as Daimler-Benz, Volkswagen, and Bayerische Motorenwerke (BMW) are known throughout the world. Almost half of all German-produced automobiles are exported, mainly to other EU members and to North America [3].

BMW AG is headquartered in

Munich, Bavaria, Germany. It also owns and produces Mini cars, and is the parent company of Rolls-Royce Motor Cars. BMW produces motorcycles under BMW Motorrad [4].

The ability to identify trends in customer preferences and take the necessary measures swiftly and properly is a critical factor for financial success [5]. The huge market demand and the increasing market shares are indicators for the high quality of BMW products [6].

What measures could be taken to improve even further the quality of BMW products? How could we define low quality? How its effects can be measured?

One of the most popular factors which companies use in order to cut production costs, improve compensation and reimbursement strategies and determine the origin of low quality is "cost of low quality" approach. With this concept it is possible to distribute higher level of enjoyment for customers and economic achievement.

Elements that assume the cost of low quality are [7]:

- Slow rate of improvement

- Bureaucracy or complexity in processes that continues to worsen
- Changes in one area tend to have large, negative effects in one or more of the other areas
- Management gets personally involved in quality problems only during a major crisis
- Management is running out of ideas as to how to cut costs further
- Not all employees are actively and personally involved in driving the organization's mission forward
- Many individuals and departments disagree on what the top priorities are for the organization
- Sub-processes and departments are operated in a manner that is detrimental to the organization's overall best interest

What is objective of such system? Each of the quality cost systems is very practical and is used to minimize production and other costs and to ensure high level of quality at the same time.

Various strategies are used as a support system for implementation of quality cost systems.

They are [7]:

- Take direct attack on failure costs in an attempt to drive them to zero
- Invest in the right prevention activities to bring about improvements
- Reduce the appraisal costs according to results achieved.
- Continuously evaluate and redirect prevention efforts to gain further improvement.

This path, using cost of quality, is really useful and confirmed to improve quality process overall. Quality process is

observed and supervised from the beginning to the end ensuring positive changes all the way, from beginning to the end of process. Choice of the best options depends of experience and ability of certain method to maintain highest results and it depends of nature of the company and/or field where it is implemented [7].

In the following the problem set is described and an approach to estimating the costs of low quality is introduced.

2. PROBLEM STATEMENT

2.1 Basic assumptions

Causes of low quality can be viewed from different perspectives.

- **Dimensions of low quality:** How can low quality be defined and measured? (e.g. difference between low quality and development).
- **"Types of costs" - perspective:** Which types of costs are impacted by low quality?
- **Processes - perspective:** what processes are causing low quality?
- **Model - building:** How the different dimensions can be integrated into a model?
- **Validation:** established using concrete data of BMW vehicles (data analysis, probability of low quality).
- **Dissatisfaction** is one of the fundamental reason for customer decay, but what causes customer dissatisfaction?
- **Conclusions:** What recommendations could be made for preventing and reacting to low quality? (E.g. Process optimization – Six Sigma, Lean management).

3. RESEARCH APPROACH

In this Section, research approach in estimation of dimensions and costs of low-quality is described.

Low quality is caused by parts of components, processes and methods that have a negative effect on the functions and the integrity of the product.

The components of Kano's model represent the elements that make up customer satisfaction. The model differentiates among three factors: basic needs, performance needs and delighters. The degree of implementation of each factor influences customer satisfaction. The following figure shows the impact of the degree of implementation on customer satisfaction depending on the three factors.

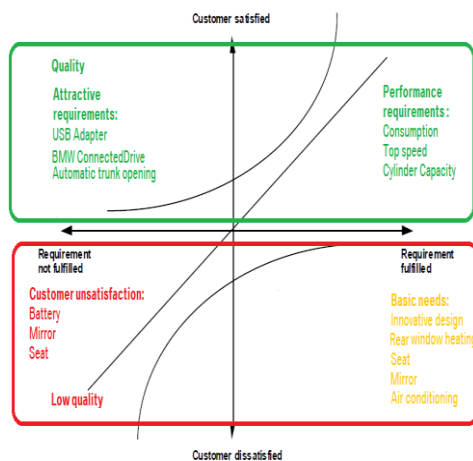


Figure 1 - Kano's model of customer satisfaction (Berger et al., 1993) [8].

The division of the elements on the figure was done based on customer demands in BMW Group.

Not fulfilling basic needs like the presence of mirror, battery, seat, etc. is a sign of low quality, which results in low customer satisfaction. On the other hand delighters like visual design, sound, ergonomics and superior handling can lead to high customer satisfaction.

Identifying the dimensions of low

quality is crucial in maintaining the competitive position of BMW vehicles.

In order to account for indirect costs literature suggests the use of activity based costing [9]. This technique tries to relate indirect costs to their root causes by defining processes and determining the corresponding costs. Thus processes become the objects of cost accounting.

Figure 2 shows a possible approach.

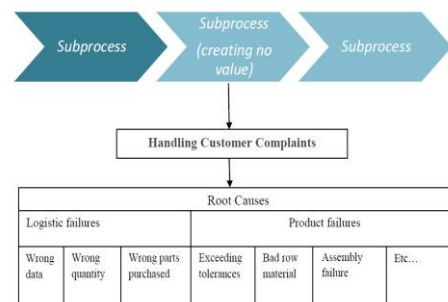


Figure 2 - Exemplary process and cause analysis (Modified figure from Ref [9]).

In the following text the most important types of costs associated with low quality are listed:

- **Direct costs:** An expense that can be identified with cost object such as department, process or product. E.g. warranty costs, Scrap costs, Supplier costs...
- **Indirect costs:** costs that are not directly accountable to particular project, facility, function or product. Customer dissatisfaction, E.g. Customer dissatisfaction, delay of the start of production...
- **Avoidable costs:** Avoidable costs are expenses that can be avoided if a decision is made to alter the course of a project or business [10]. E.g. Not realized sales volume, Scrap costs, Warranty costs...
- **Reactive costs:** Overall costs after production. E.g. Warranty costs, Scrap costs...

- **Preventive costs:** An expense incurred as part of the quality control efforts of a business performed in order to avoid having defective products reach consumers [11]. E.g. Quality planning, inspection planning.
- **Conformity costs:** Costs of preventive character which are thus projectable. E.g. testing, prevention of mistakes, ...
- **Non conformity costs:** Costs for correction of mistakes or repetition of tests. These are also known as costs of non-quality. E.g. Scrap costs, Waste costs ...

Another factor that plays an important role in judging the quality of a product is the demographic characteristics of the different markets that BMW serves. Customer preferences vary from country to country and depend strongly on regional and cultural factors. Media reviews and social media sentiment also affect strongly customers' perceptions of products.

In order to identify the costs of low quality we analyse data about workshop visits, customer feedback, avoidable costs during the production and quality control mechanisms. After costs are known we try to find their root causes and then determine the process steps which have to be optimized in order to lower the costs.

In addition, statistical modeling and analysis tools such as *R* and *SPSS* are employed. Direct costs are derived from the Product-Development-Process, warranty costs and goodwill and the indirect costs are the result of low customer satisfaction, inferior reviews in the offline and online media. Other factors such as company image, customer expectations and perceived price will be modeled in the simulations in order to analyse customer loyalty and the effect of perceived quality on customer satisfaction.

An important part in examining the quality is, of course, hearing the thoughts

and opinions of the employees. In line with that, we will prepare a questionnaire modeled like one which was applied at Toyota [12]. Also, important parts are social competences and working conditions as well as considering the things that the employees would like to see changed or improved or suggest in order to further improve the process.

Because suppliers are a crucial part of the value creation chain, they are closely examined based on the quality of their products. Statistical audit measures on the quality of the supplied products are an integral part of the analysis.

In the final step, process mining is used to depict and analyze the relationships among customers, suppliers and Product-Development-Process. This way organizational processes and policies could be optimized in order to increase their efficiency and lower the probability of delivering inferior value to the customers (low quality and level of service). Another technique that could be used to analyze the dependencies among all the stakeholders in the value creation chain and identify causal effects is Fault-Tree analysis, which is based on Boolean algebra and probability theory. In addition characterization techniques will be done on some of the components which show the low quality.

4. CONCLUSION

Low quality costs could be divided in direct and indirect costs. Direct costs could be easily estimated through warranty costs, scrap costs, development costs etc. Indirect costs are the result of low customer satisfaction, which is caused by inferior product quality. In analyzing the causes of low quality an integrated model of internal processes, suppliers (and sub-suppliers) and customer preferences will be developed. Process mining is used to ascertain the effectiveness of internal

production processes. Fault-Tree analysis examines the relationships between the materials that constitute the vehicle in terms of geometry and functionality. Kano's model is used to analyze the factors that shape customers' preferences

and attitudes towards the examined vehicles. All of the above mentioned methods, when applied correctly, can lower the probability of low quality occurrence and therefore help in avoiding of the associated costs.

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