

Use of the Quality Loss Function for Improving the Productive Processes in the General Company for the Automotive Industry – Alexandria – An Applied Research

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The study focused on the problem of low quality and high number of defective products as well as multiple defects in the General Company for the automotive industry. The purpose of the research is to detect the effect of the use of Taguchi's loss function in improving production processes and determining the causes of deviations in the production process, which in turn helps to decrease their quality level and develop appropriate solutions. In order to achieve the above research objectives and reduce the percentage of defects to reach them and to detect deviations in the outputs of the production process was designed program using the language (Microsoft Visual Studio 2015) for the operation of (Taguchi technology).

Key words: *The Quality Loss Function.*

Introduction

The strong design is not only stable, flexible, flawless, simple and effective, but it is also a product that achieves a high level of performance and stability despite exposure to different conditions and effects during use and operation as well as during production.

In conventional engineering, problem-solving and problem-solving are done by resorting to trial and error by repeating the processes (design, construction, and test) so that the optimal solution can be achieved. In the event of a problem or extensive study of the problems

resulting from the overlap of variables and all these methods cost is high, and it takes longer and is not guaranteed to succeed every time.

As for using the roads d. Taguchi Experiments are carried out by designing models that are tested under the influence of several factors at the same time and with changing these factors at a time so that the product / process of production is not sensitive and are not affected by factors that are difficult / impossible to control at reasonable prices. The main objective of the research is to use the loss function of Taguchi for the purpose of improving the company's research sample products. This can be achieved through a set of sub-goals Agencies:

1. Identify the type of production problems and analyze the root causes behind the emergence of the latter, and try to find solutions and take the necessary measures to address them.
2. What are the costs incurred by the company as a result of the production away from the target specifications.
3. Identify the methods used in the company to address deviations from the target quality specifications.
4. Reduce the amount of damaged products and reduce the total defects of the product and thus contribute to reduce production costs and cost of quality.

Research Methodology

The researcher found through the repeated field visits to the General Company for the automotive industry (the sample of the research) a lot of defects in the units produced by the many problems in the production processes, and based on the above can identify the problem of research through the following questions:

1. Are there differences in the profits of the production process when using advanced technology such as QLF?
2. How can an inspected company measure its quality? , And does it have a reliable measurement technique?
3. Does QLF help raise the quality of the company in question?

The process of solving the problem of the search on a set of tools is the following:

1. Designing a system that includes a program to apply the equations and steps of the Taguchi function using Visual Studio 2015 programming, which is one of the latest versions of Microsoft's C # programming language.
2. Using Microsoft Excel 2010 to write and call data.

Conceptual Fretwork

Taguchi Function Concept

In all manufacturing systems there are some deviations and variations in manufacturing processes that lead to deviation and variation in the characteristics of products such as hardness, weight, height, etc., which may cause poor quality. The causes of these deviations in the systems are due to the variation of the raw materials used or the variation in the performance of the machines and equipment resulting from the extinction and continuous use, or the deviations may occur as a result of the stress exerted on the worker due to the length of work or fatigue or other reasons. New products and processes for product development and processes and make them achieve access to production of products that are less sensitive to changes, as well as variations and differences in the characteristics and specifications of products during the manufacturing process. His philosophy is on The basis of the WE Deming observation is that 85% of the reasons for poor or poor quality are due to problems and errors in the manufacturing process, and only 15% belong to the operator. Therefore, Taguchi has developed "strong" manufacturing systems that are robust and are not sensitive to daily or seasonal changes to the environment and changes in machine capacity and other external factors.

The idea of Taguchi methods is a cost-linked engineering quality system that focuses on the effective application of engineering strategies rather than the use of advanced statistical methods. This includes application in the early stages of product design and during different production stages. The methods used in the early stages are mainly based on small-scale statistical experiments to reduce the likelihood of change, taking into account the creation of a strong product at a suitable price that can be produced in large quantities. As for the techniques used during the production stages, it depends on the control of production during its various stages to ensure the quality and the right price. Generally, the more these methods are implemented in the early stages of design, the greater the return will be. This will save a lot of money and time and most of the applications used by the methods. Taguchi was mainly focused on these two elements:

1. Improve the quality of an existing product
2. Improve the quality of the performance of a product's production method.

Different ways d. Taguchi for the rest of the other methods and techniques that focus on solving quality problems in that it focuses on solving the quality problems in the early stages of design and in the development of production. Note that the key to excellence in the competition in the market currently is to offer a product of high quality at a timely and appropriate price. Taguchi's view on building quality in a product or process, by reducing variation (through what is known as "durability construction"), is an intellectual revolution in quality engineering that has challenged traditional quality control methods (Hendar &

Kartikab, 2019) The idea of the loss of society, which results from the deviation of functional characteristics (or "quality attribute") of the product from the target (or desirable), although it is purely mathematical in nature but has a cultural aspect (Sabita, Ghadhbanb & Abbasc, 2020), and by definition of quality as "the loss of society from the time of shipment of the product" (Shamsudin et al., 2019) reflects two values The two are looking forward to perfect "optimization" and work for the common good, as he speaks while the industrial world is satisfied with the customer thinks and seeks Taguchi towards helping society, which is a manifestation of Japanese cultural (Suaedia & Agung, 2020).

(McAuliffe & Winter, 2013) noted that Taguchi deals with three basic concepts: first, quality, quality improvement, quality control, quality control, and loss of quality and loss of society as a whole. In the second, and the third is achieved through the use of statistical quality control maps as well as Feedback. In addition to previous concepts, Taguchi pointed to two types of factors: the first control or control factors that are under control; the other are environmental factors or so-called uncontrollable noise factors or control in which.

Contributions of the Scientist "Taguchi"

Taguchi has made many contributions to the improvement and development of quality both for the product and for the process. Taguchi does not agree with traditional quality ideas, which usually allow discrepancies as long as they are within the permissible limits. He emphasized that any deviation from the target value constitutes a loss even if (Foster, 2013: 40) since it considers the loss to be zero if the characteristics and specifications of the product / service at the target value, while taking the multiplication double if approaching the boundary, as shown in Figure (1).

Figure 1. Losses Function for Taguchi



Krajewski L. J., Ritzman L. P. , Malhotra M. K., (2013) ' *Operations Management : Processes And Supply Chains*' Global Edition , (10th Edi.) , Pearson Education Limited , P201
The idea of Taguchi focuses on achieving the goals accurately without any losses, not only by keeping the specifications of the products within the limits of the specific specifications, but by specifying a target point that must be achieved exactly (Al-Barwari & Bashiwa, 2011) which came in line with Crosby's view, Taguchi defines quality according to the loss function as "the loss caused by the product to the society from the time it is shipped to the market." The function of the quality loss function is the quantitative evaluation of that Loss resulting from product functional variation. (Taguchi, Chowdhury & Wu, 2005)

Taguchi gave three types of loss functions which are as follows (Masoudi, 2010: 76:)

When any deviations from the target occur, the loss function is written as follows:

$$QLF = L (y) K [(y-T)]^2 \dots \dots (1)$$

When the objective is to make the properties of the process small, as in the case of the impurity of a small piece of steel) is written as follows:

$$QLF = L (y) [K (y)]^2 \dots \dots (2)$$

When the objective is to make the properties of the process large (as in the reliability of the safety means), write the following formula:

$$QLF = L (y) [K (1 / y)]^2 \dots \dots (3)$$

L: the cost of loss, T: the target value, K: the technical parameter constant, which is calculated through

$$K = C / D^2 \dots \dots (4)$$

Where: C: loss due to non-conformity, D²: square difference between the upper and lower limit and the middle of the standard value, y: the value of the real cost of quality

It is worth noting that the view of Taguchi agreed with the modern orientations of the expression of loss and differed with those of the traditional, as shown in Figs. (2-a) and (2-b)

Figure (2-a)

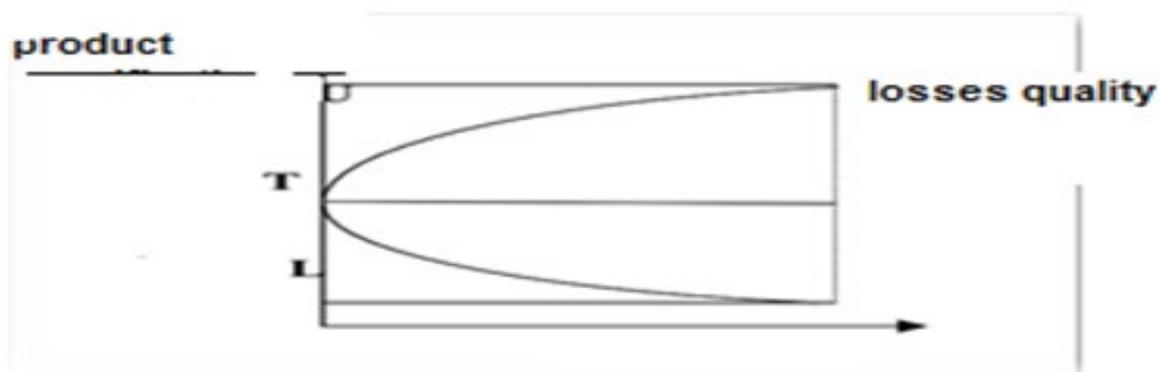
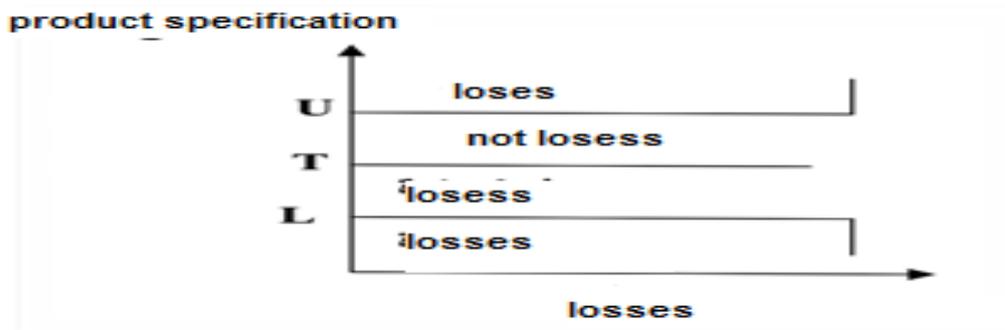


Figure (2-b)



We conclude that the conventional view of loss is that products are of acceptable quality as long as they fall within the limits of control (the limits of the specifications set) and are of equal quality regardless of their proximity or distance from those limits, Unlike the Taguchi view, which is considered to be the loss once the deviation from the target specification (target value) has occurred, and no matter how far from the latter, it is beyond Target (TV).

If the resistance of 22 copper wires was taken as an example, the resistance would be 91 ± 0.5 ohms. This is based on the traditional view. Taguchi's view is that resistance should be 91 ohm. Taguchi is considered resistance wire $(91) \pm 0.5$ ohm outside the required specifications and must be returned to manufacturing processes or considered from waste (damaged), as Taguchi focuses on exactly matching the target value. (Sahbat, Khashea & Hammood, 2018) The Taguchi is based on a set of foundations, among which: The cost can be reduced by improving the quality, and the quality can be improved without increasing the costs. (Wadsworth et al., 2002: 456), And that improving quality is a goal that can be achieved by reducing deviations, quantifying the costs quantitatively and relying on conformance to specifications, not just acceptance of the product. Taguchi has formulated a loss function for quality as follows:

$$L = K(y - T)^2 \dots (5)$$

Loss, K: constant (cost factor), y: actual product cost, T: target value in order to evaluate one unit of the product. In evaluating the number of products, the following equation is used:

$$L = K(MSD) \dots (6)$$

MSD: Mean Squared Deviation

In the case of n products, the following equation is used:

$$L = \frac{K(y_1-T)^2 + K(y_2-T)^2 + \dots + K(y_n-T)^2}{n}$$

$$= K \frac{(y_1 - T)^2 + (y_2 - T)^2 + \dots + (y_n - T)^2}{n} \dots (7)$$

$$\begin{aligned} MSD &= \frac{1}{n} \sum_{i=1}^n (y_i - T)^2 \\ &= \frac{1}{n} \sum_{i=1}^n (y_i - \bar{y})^2 + (\bar{y} - T)^2 \\ &= \frac{(y_1 - \bar{y})^2 + \dots + (y_n - \bar{y})^2}{n} + (\bar{y} - T)^2 \\ &= \sigma^2 + (\bar{y} - T)^2 \dots (8) \end{aligned}$$

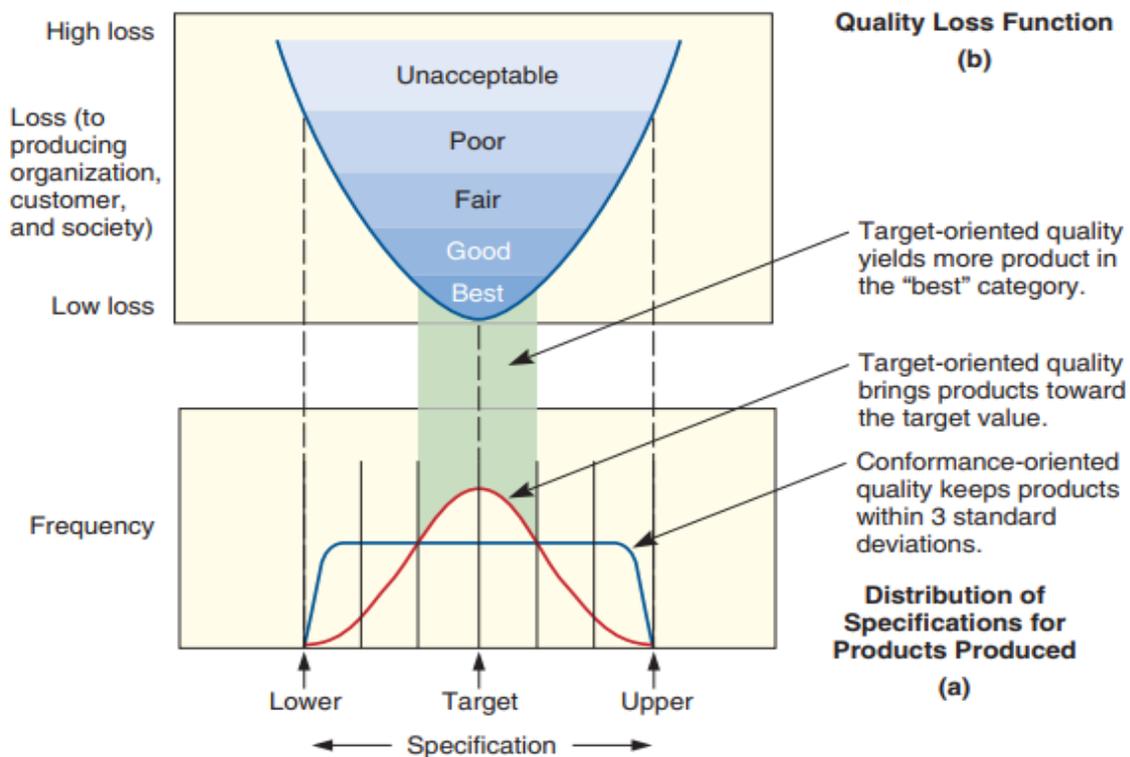
As: \bar{y} : average y (actual quality of products)

In the case of more than one unit, then the last equation will be as follows:

$$L = K * [\sigma^2 + (\bar{y} - T)^2] \dots (9)$$

Σ^2 (2): the variance around the mean is the deviation of the mean \bar{y} from the target
The goal here is to minimize the loss by reducing MSD by reducing the deviation from the mean σ^2 and adjusting the mean to the MSD target (Taguchi, Chowdhury & Wu, 2005).

Figure 3. Quality loss function and quality target



Heizer J., Render B. , Munson C. , (2017) : *Operations Management – Sustainability And Supply Chain Management* , (12th Ed). , United States of America , Pearson Education, Inc. , P225

(Andonov, 2017: 123-124) said that in 2015, more than 30 million vehicles were notified to the driver's airbag, which was produced by Japan's Takata Company, as there were strange explosions that caused many casualties , So many companies in the world have been advised to change these airbags, because their quality is not conforming to the specifications, which caused great losses to Takata, so companies have to calculate the cost of quality during the manufacturing process and after (after delivery of the product) On the performance of the functions depend on the performance of the cost companies huge funds resulting from customer complaints In some cases products are considered irreparable, so companies have to conform to the exact specifications and characteristics of those planned. Some products do not accept defects at all, as they relate to safety and human life, as in the previous example that is pharmaceutical industry as well as other industries.

A. Robust Design (RD): Taguchi believes that the best design of a product is a little or no sensitive to changes that occur during the manufacturing process rather than trying to adjust those changes, so focus on maximizing both the product and the process before the manufacturing process as an alternative to the necessary tests during the process Manufacturing, who pointed out that the meaning of solid design, product design meets customer requirements even if the conditions are unfavorable and inappropriate, so that the product is designed to resist changes and differences in the process of manufacturing and / or assembly (Heizer et al. 2017).

B. Target Quality (TQ): Focuses on the concept of continuous improvement of quality at the design stage, in order to make product quality exactly at target value. Continuous improvement is focused on reducing the change in product performance characteristics around the target value continuously and continuously. It works to remove damage and losses but also improves quality by moving from control to target value (Heizer et al., 2017). As shown in Figure 3.

C. Signal to Noise Ratio (S / N): Taguchi has disseminated the concept of signal-to-noise ratio used in communications to be used in the design of measurement systems in the manufacturing processes of products and services (Taguchi et al., 2005: 224) (Yang, 2007: 157) indicates that in the context of the strong design that Taguchi introduced, the signal enters the product and turns into target functions as well as the patterns of failure, and the ratio of their ability to failure patterns is the ratio of signal to noise, Taguchi to measure the durability of products and processes.

Cost of Quality

Due to the increase in the cost of quality due to the complexity of manufacturing processes and the advancement of technology, as well as the desire of quality engineers and operations managers to influence these costs through supporting the senior management to evaluate, study and analyze them to make the necessary decisions thereon as well as due to the negative effects caused by the poor quality costs and the need to avoid them through Producing high quality products. As a result, the cost of quality has become a tool of financial control and has become associated with the production, protection and repair of products to meet pre-set standards (Alwan, 2005: 51). Quality costs are divided into two parts as follows (Morton et al, 2008; Christopher et al., 2011; Blocher et al., 2010; Nieuwenhuizen et al., 2012):

1. Evaluation (Appraisal Costs): It is related to the evaluation of the resources and customers of the purchased materials, and is related to the costs spent on the screening process to ensure that the products meet the specific requirements and include:

- Inspection: Inspection of incoming materials, cost of preparation and preparation, costing of manufacturing processes, costs of testing of final products / services, and costs of evaluating product / service performance as well as pre-set specifications.
- Costing quality audit: Verify that the quality management system works correctly and according to what is planned.
- Cost Inspection and Inspection Equipment: Inspection and maintenance of equipment used in all inspection and inspection activities.
- Costing Evaluation of Processors: Evaluation and approval of all processors and for each product and service.
- Prevention costs: These costs are related to the design, implementation and maintenance of quality management systems, which are spent before manufacturing.

Cost of failure

- Internal Failure Costs: These costs are shown when the product / service fails to reach the designed standards and the failure is detected before it reaches the customer,
- External Failure Costs: Occur when the products / services do not reach the quality standards in the design and are not disclosed until they reach the customer.

Results

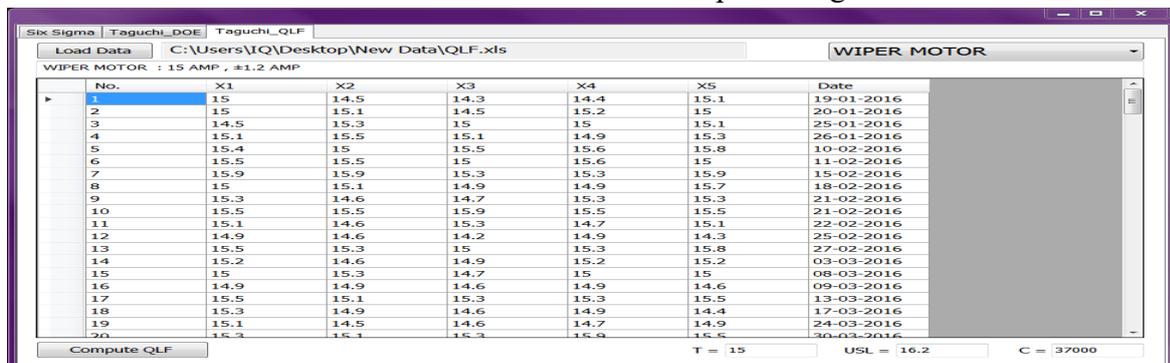
Application of Quality Loss Function (QLF) in the General Company for the Automobile Industry When you click on the program, the program interface displays six sub-options. The first option is "Load Data" to download the data. The Microsoft Excel 2010 program was

used to write and call the data for extracting the loss function for the assembly line and the second to select the part to extract the function for. Third, fourth and fifth are to write the target value, the upper limit of the set, the value of the failure cost (internal and external), respectively, the sixth option "Compute QLF" is to calculate the function, when pressing the last option shows the program interface result of the loss function, M N through a set of steps which are as follows:

1. $(\bar{X} - T)^2$
2. $\sigma^2 = \left(\frac{\bar{R}}{d_2}\right)^2$
3. $K = \frac{C}{D^2}, D^2 = USL - T$
4. $QLF = \left[(\bar{X} - T)^2 + \sigma^2 \right] * K$

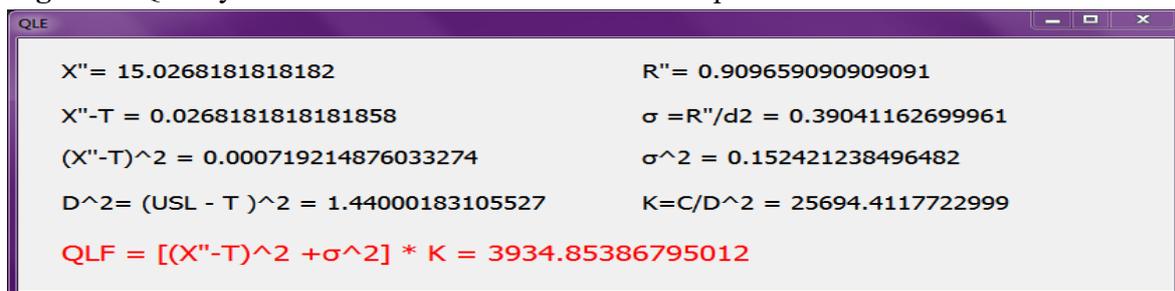
Where: j: sequence of samples $j = 1, 2, 3, \dots, n$. i: sequence of observations for each sample $i = 1-5$. Target Value. The cost of the failure of the product after the arrival of the latter in the customer's hand, which is the cost of the reputation and position of the company and the cost of the market share lost from Company subject to competitors), on the difference box between the upper limit of the specification and the target value D2. The sample sequence, first watch, second watch, third watch, fourth watch, fifth watch, test date, and 176 search samples were recorded, each with five observations starting from 19-01-2016 to 02-04-2017: (15) And the maximum value (USL) is 16.2 mb. , And the cost of loss (C) 37000 dinars.

Table 1: Front View of the Windscreen Windshield wipers - Taguchi



No.	X1	X2	X3	X4	X5	Date
1	15	14.5	14.3	14.4	15.1	19-01-2016
2	15	15.1	14.5	15.2	15	20-01-2016
3	14.5	15.3	15	15	15.1	25-01-2016
4	15.1	15.5	15.1	14.9	15.3	26-01-2016
5	15.4	15	15.5	15.6	15.8	10-02-2016
6	15.5	15.5	15	15.6	15	11-02-2016
7	15.9	15.9	15.3	15.3	15.9	15-02-2016
8	15	15.1	14.9	14.9	15.7	18-02-2016
9	15.3	14.6	14.7	15.3	15.3	21-02-2016
10	15.5	15.5	15.9	15.5	15.5	21-02-2016
11	15.1	14.6	15.3	14.7	15.1	22-02-2016
12	14.9	14.6	14.2	14.9	14.3	25-02-2016
13	15.5	15.3	15	15.3	15.8	27-02-2016
14	15.2	14.6	14.9	15.2	15.2	03-03-2016
15	15	15.3	14.7	15	15	08-03-2016
16	14.9	14.9	14.6	14.9	14.6	09-03-2016
17	15.5	15.1	15.3	15.3	15.5	13-03-2016
18	15.3	14.9	14.6	14.9	14.4	17-03-2016
19	15.1	14.5	14.6	14.7	14.9	24-03-2016
20	15.3	15.1	15.3	15.9	15.5	30-03-2016

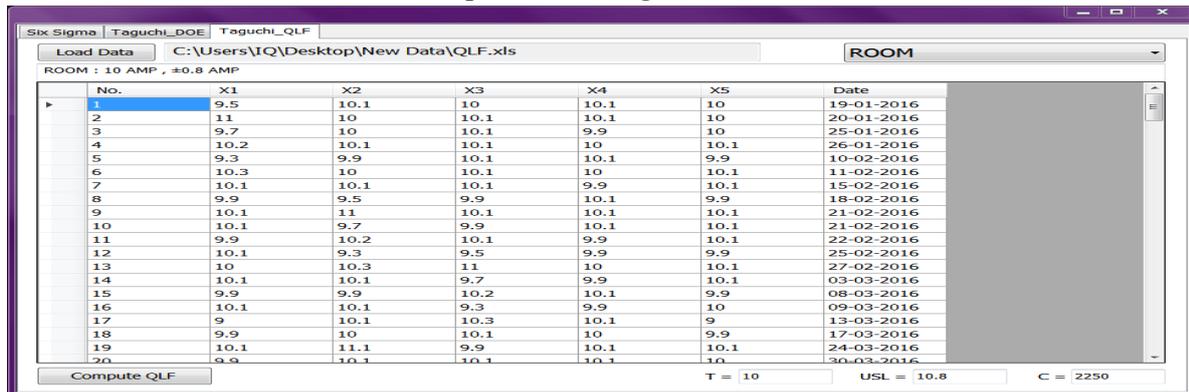
Figure 4. Quality loss function - Master windshield wipers



X'' = 15.0268181818182	R'' = 0.909659090909091
X''-T = 0.0268181818181858	$\sigma = R''/d_2 = 0.39041162699961$
$(X''-T)^2 = 0.000719214876033274$	$\sigma^2 = 0.152421238496482$
$D^2 = (USL - T)^2 = 1.44000183105527$	$K = C/D^2 = 25694.4117722999$
QLF = $[(X''-T)^2 + \sigma^2] * K = 3934.85386795012$	

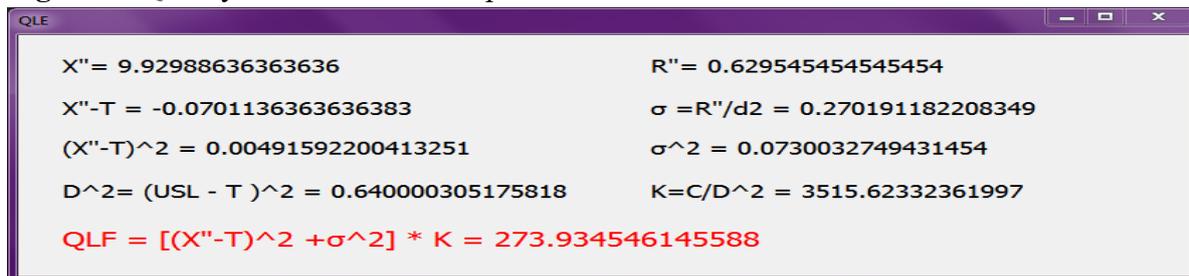
2. Box lamp: 10 mb, $0.8 \pm$ mb: Table 2 represents the indicator light interface of the box where we can observe the target value (T) 10 amp, the tolerance limits ± 0.8 amps, the upper limit (USL) 10.8 amps, the cost of loss (C) 2250 dinars.

Table 2: Interface of the Fund Lamp Views – Taguchi



No.	X1	X2	X3	X4	X5	Date
1	9.5	10.1	10	10.1	10	19-01-2016
2	11	10	10.1	10.1	10	20-01-2016
3	9.7	10	10.1	9.9	10	25-01-2016
4	10.2	10.1	10.1	10	10.1	26-01-2016
5	9.3	9.9	10.1	10.1	9.9	10-02-2016
6	10.3	10	10.1	10	10.1	11-02-2016
7	10.1	10.1	10.1	9.9	10.1	15-02-2016
8	9.9	9.5	9.9	10.1	9.9	18-02-2016
9	10.1	11	10.1	10.1	10.1	21-02-2016
10	10.1	9.7	9.9	10.1	10.1	21-02-2016
11	9.9	10.2	10.1	9.9	10.1	22-02-2016
12	10.1	9.3	9.5	9.9	9.9	25-02-2016
13	10	10.3	11	10	10.1	27-02-2016
14	10.1	10.1	9.7	9.9	10.1	03-03-2016
15	9.9	9.5	10.2	10.1	9.9	08-03-2016
16	10.1	10.1	9.3	9.9	10	09-03-2016
17	9	10.1	10.3	10.1	9	13-03-2016
18	9.9	10	10.1	10	9.9	17-03-2016
19	10.1	11.1	9.9	10.1	10.1	24-03-2016
20	9.9	10.1	10.1	10.1	10	30-03-2016

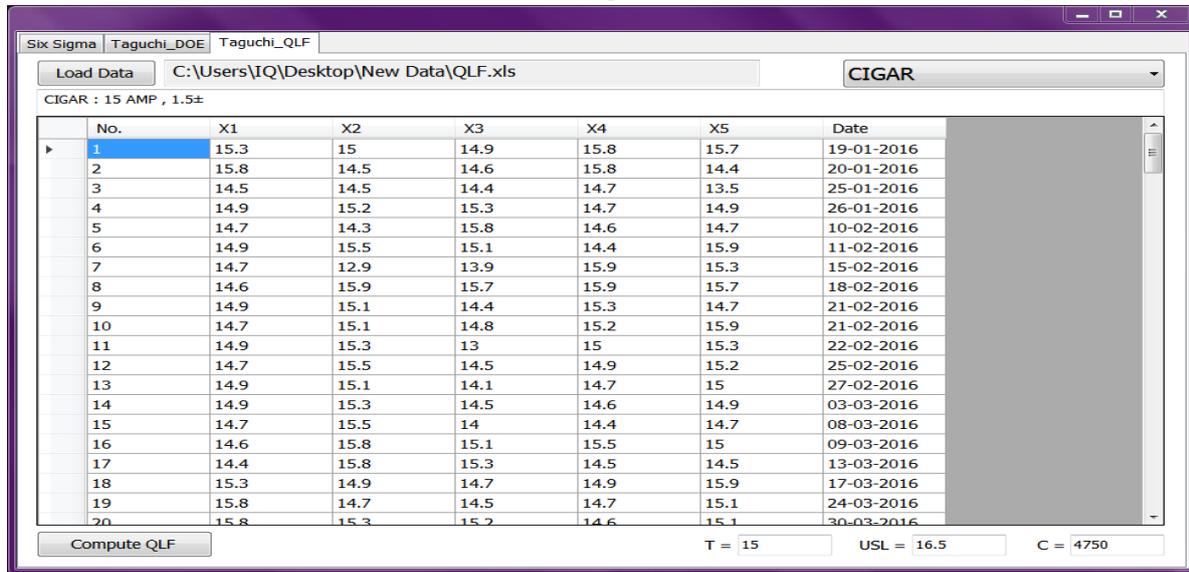
Figure 5: Quality loss function - lamp box



$X'' = 9.92988636363636$	$R'' = 0.629545454545454$
$X'' - T = -0.0701136363636383$	$\sigma = R''/d2 = 0.270191182208349$
$(X'' - T)^2 = 0.00491592200413251$	$\sigma^2 = 0.0730032749431454$
$D^2 = (USL - T)^2 = 0.640000305175818$	$K = C/D^2 = 3515.62332361997$
$QLF = [(X'' - T)^2 + \sigma^2] * K = 273.934546145588$	

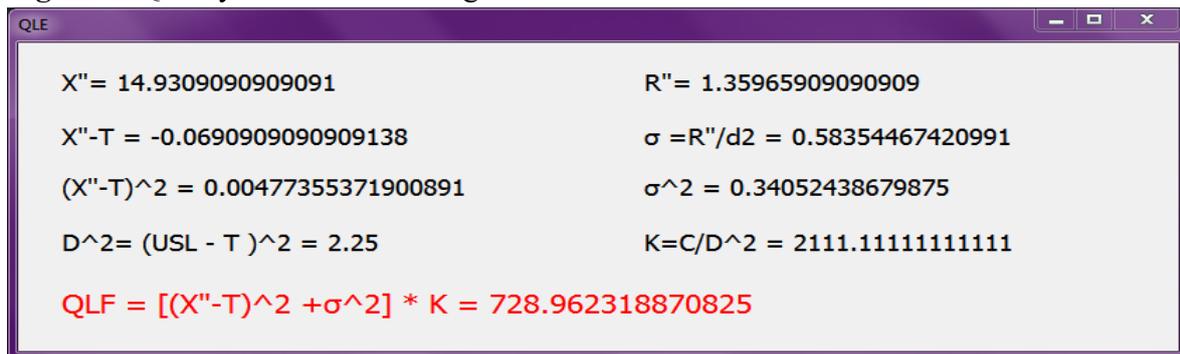
3. Lumen: 15 mb, ± 1.5 mb. In Table 3, the frontal view is 15 amperes ± 1.5 m, the target value (T) 15, the upper limit (USL) is 16.5 and the cost of loss is C (4750).

Table 3: Interface of the Uranium Views – Taguchi



No.	X1	X2	X3	X4	X5	Date
1	15.3	15	14.9	15.8	15.7	19-01-2016
2	15.8	14.5	14.6	15.8	14.4	20-01-2016
3	14.5	14.5	14.4	14.7	13.5	25-01-2016
4	14.9	15.2	15.3	14.7	14.9	26-01-2016
5	14.7	14.3	15.8	14.6	14.7	10-02-2016
6	14.9	15.5	15.1	14.4	15.9	11-02-2016
7	14.7	12.9	13.9	15.9	15.3	15-02-2016
8	14.6	15.9	15.7	15.9	15.7	18-02-2016
9	14.9	15.1	14.4	15.3	14.7	21-02-2016
10	14.7	15.1	14.8	15.2	15.9	21-02-2016
11	14.9	15.3	13	15	15.3	22-02-2016
12	14.7	15.5	14.5	14.9	15.2	25-02-2016
13	14.9	15.1	14.1	14.7	15	27-02-2016
14	14.9	15.3	14.5	14.6	14.9	03-03-2016
15	14.7	15.5	14	14.4	14.7	08-03-2016
16	14.6	15.8	15.1	15.5	15	09-03-2016
17	14.4	15.8	15.3	14.5	14.5	13-03-2016
18	15.3	14.9	14.7	14.9	15.9	17-03-2016
19	15.8	14.7	14.5	14.7	15.1	24-03-2016
20	15.8	15.3	15.2	14.6	15.1	30-03-2016

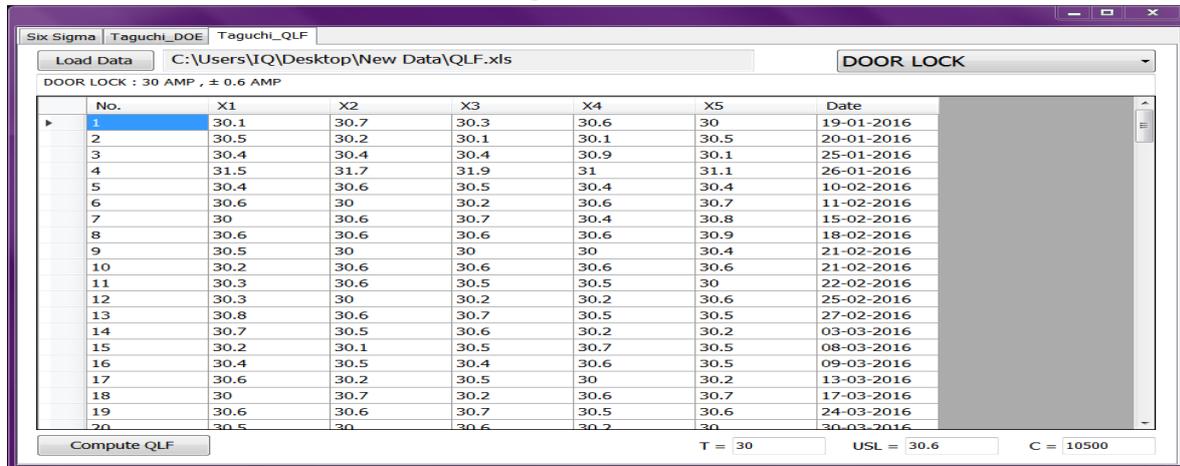
Figure 6. Quality loss function - Lighter



$X'' = 14.9309090909091$	$R'' = 1.35965909090909$
$X'' - T = -0.0690909090909138$	$\sigma = R''/d2 = 0.58354467420991$
$(X'' - T)^2 = 0.00477355371900891$	$\sigma^2 = 0.34052438679875$
$D^2 = (USL - T)^2 = 2.25$	$K = C/D^2 = 2111.11111111111$
$QLF = [(X'' - T)^2 + \sigma^2] * K = 728.962318870825$	

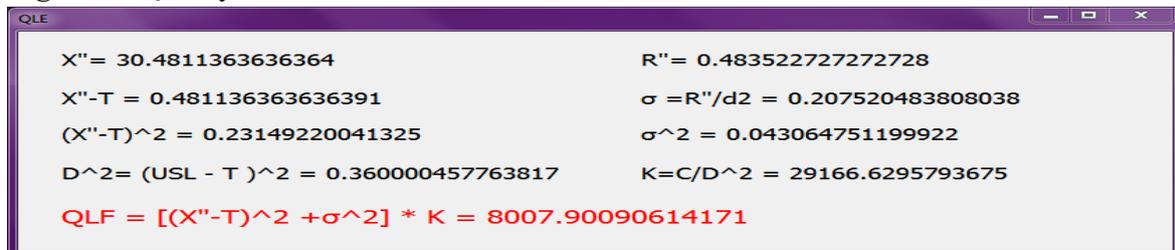
4. The central lock: 30 mb, 0.6 mb. Table 4 represents the central locking sight interface: 30 mA, ± 0.6 mA, and the target value (T) is 30 mA, the high limit (USL) 30.6 MA,) 10500 dinars.

Table 4: Door lock views interface – Taguchi



No.	X1	X2	X3	X4	X5	Date
1	30.1	30.7	30.3	30.6	30	19-01-2016
2	30.5	30.2	30.1	30.1	30.5	20-01-2016
3	30.4	30.4	30.4	30.9	30.1	25-01-2016
4	31.5	31.7	31.9	31	31.1	26-01-2016
5	30.4	30.6	30.5	30.4	30.4	10-02-2016
6	30.6	30	30.2	30.6	30.7	11-02-2016
7	30	30.6	30.7	30.4	30.8	15-02-2016
8	30.6	30.6	30.6	30.6	30.9	18-02-2016
9	30.5	30	30	30	30.4	21-02-2016
10	30.2	30.6	30.6	30.6	30.6	21-02-2016
11	30.3	30.6	30.5	30.5	30	22-02-2016
12	30.3	30	30.2	30.2	30.6	25-02-2016
13	30.8	30.6	30.7	30.5	30.5	27-02-2016
14	30.7	30.5	30.6	30.2	30.2	03-03-2016
15	30.2	30.1	30.5	30.7	30.5	08-03-2016
16	30.4	30.5	30.4	30.6	30.5	09-03-2016
17	30.6	30.2	30.5	30	30.2	13-03-2016
18	30	30.7	30.2	30.6	30.7	17-03-2016
19	30.6	30.6	30.7	30.5	30.6	24-03-2016
20	30.5	30	30.6	30.2	30	30-03-2016

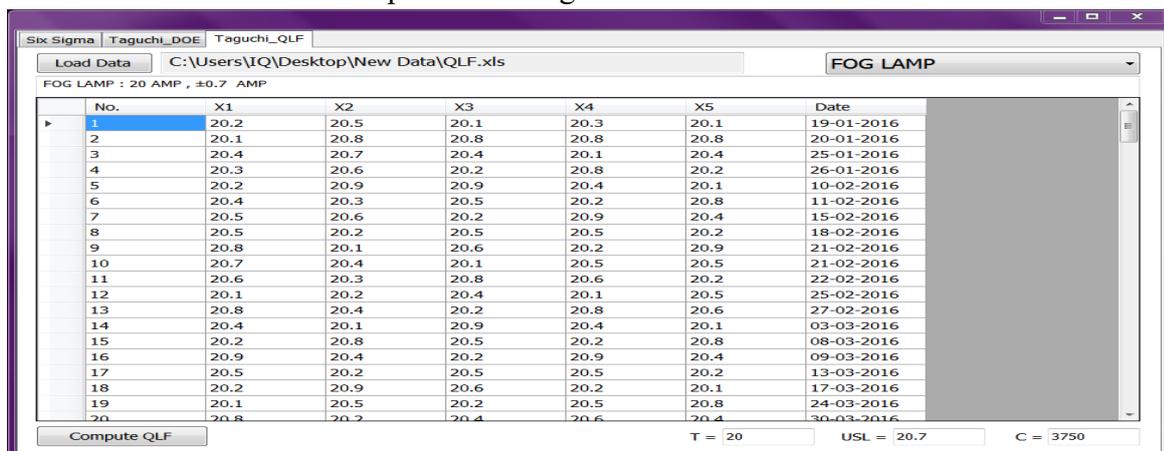
Figure 7. Quality loss function door lock



$X'' = 30.4811363636364$ $R'' = 0.483522727272728$
 $X''-T = 0.481136363636391$ $\sigma = R''/d2 = 0.207520483808038$
 $(X''-T)^2 = 0.23149220041325$ $\sigma^2 = 0.043064751199922$
 $D^2 = (USL - T)^2 = 0.360000457763817$ $K = C/D^2 = 29166.6295793675$
 $QLF = [(X''-T)^2 + \sigma^2] * K = 8007.90090614171$

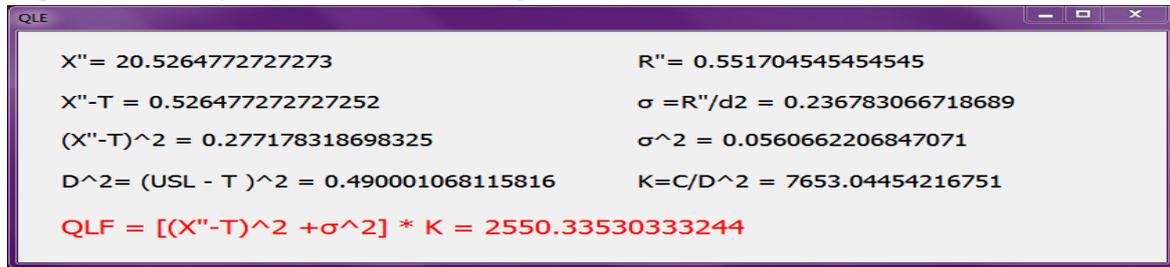
5. Front lamp (anti-fog) (high-low): 20 mb, 0.7 mb: Table 5 represents the headlight viewing interface: 20 amps, ± 0.7 amperes, and the target value (T) 20 amp, USL) 20.7 Amp, and the cost of loss (C) 3750 dinars.

Table 5: Interface Front Lamp Views – Taguchi



No.	X1	X2	X3	X4	X5	Date
1	20.2	20.5	20.1	20.3	20.1	19-01-2016
2	20.1	20.8	20.8	20.8	20.8	20-01-2016
3	20.4	20.7	20.4	20.1	20.4	25-01-2016
4	20.3	20.6	20.2	20.8	20.2	26-01-2016
5	20.2	20.9	20.9	20.4	20.1	10-02-2016
6	20.4	20.3	20.5	20.2	20.8	11-02-2016
7	20.5	20.6	20.2	20.9	20.4	15-02-2016
8	20.5	20.2	20.5	20.5	20.2	18-02-2016
9	20.8	20.1	20.6	20.2	20.9	21-02-2016
10	20.7	20.4	20.1	20.5	20.5	21-02-2016
11	20.6	20.3	20.8	20.6	20.2	22-02-2016
12	20.1	20.2	20.4	20.1	20.5	25-02-2016
13	20.8	20.4	20.2	20.8	20.6	27-02-2016
14	20.4	20.1	20.9	20.4	20.1	03-03-2016
15	20.2	20.8	20.5	20.2	20.8	08-03-2016
16	20.9	20.4	20.2	20.9	20.4	09-03-2016
17	20.5	20.2	20.5	20.5	20.2	13-03-2016
18	20.2	20.9	20.6	20.2	20.1	17-03-2016
19	20.1	20.5	20.2	20.5	20.8	24-03-2016
20	20.8	20.2	20.4	20.6	20.4	30-03-2016

Figure 8. Quality loss function - headlight



$$3520^2 * 15495.984 = 54545863.68 \text{JD}$$

And that if compared to revenues for the actual production volume, it will represent the percentage of:

$$54545863.68 / 36960000000^4 = 0.14\% \text{ of sales volume}$$

It is possible to observe the losses caused by deviations from the specifications set which the company must overcome by taking a set of procedures that reduce the percentage of defects and deviations and try to reach zero defects. Therefore, a reduction rate of 5%, 10% and 15% to indicate the savings that the company will achieve, as shown below:

Table 6: Proposed 5% reduction of deviations in the company

Parts	QLFC	σ^2 SUGGEST	QLFS	Saving suggested costs	Annual suggested saving cost
Wipers motor	3934.8538	0.1448	3738.5369	196.7426	838123.476
Lump box	273.9345	0.0694	261.2108	13.6967	58347.942
lighter	728.9623	0.3235	692.8666	36.4481	155268.906
Door locks	8007.9009	0.0409	7942.0732	400.3950	1705682.7
Fog light	2550.3353	0.0532	2527.8005	127.5167	543221.142

Therefore, the total annual savings that will be achieved if the company followed the reduction procedures by 5% will be equal to 3300644.166 dinars annually

Table 7: Proposed 10% reduction of deviations in the company

Parts	QLFC	σ^2 SUGGEST	QLFS	Saving suggested costs	Annual suggested saving cost
Wipers motor	3934.8538	0.1372	3543.2593	393.4853	1676247.719
Lump box	273.9345	0.0657	248.2030	27.3934	116696.097
lighter	728.9623	0.3065	656.9777	72.8962	310537.812
Door locks	8007.9009	0.0387	7877.9066	800.7900	3411365.4
Fog light	2550.3353	0.0504	2506.3720	255.0335	1086442.71

Therefore, the total annual savings that would be achieved if the company followed the reduction procedures by 10% would be equal to 6601289.738 dinars annually

Table 8: Proposed 15% reduction of deviations in the company

Parts	QLFC	σ^2 SUGGEST	QLFS	Saving suggested costs	Annual suggested saving cost
Wipers motor	3934.8538	0.1296	3347.9818	590.2280	2514371.28
Lump box	273.9345	0.0621	235.5467	41.0901	175043.826
lighter	728.9623	0.3255	697.0888	109.3443	465806.718
Door locks	8007.9009	0.0366	7816.6567	1201.1851	5117048.526
Fog light	2550.3353	0.0476	2484.9435	382.5502	1629663.852

Therefore, the total annual savings that will be achieved if the company followed the reduction procedures by 15% will be equal to 9901934.202 dinars per year. In this section, the Taguchi function was used in the assembly line (in the General Company for the Automobile Industry - Saipa car assembly). When applying QLF, the following can be observed:

1. The proposed QLF at 5% reduction rate was down by 196.3169 for the current QLF for the scanners, 12.7237 for the current QLF for the lamp beam, 36.0957, 65.8277 and 22.5348 for the current QLF for the central lock, central lock and fog lamp, respectively.
2. QLF proposed for the current QLF at a 10% reduction rate is equal to 91.5945, 25.7315, 71.9846, 129.9943, 43.9633 for the scatter model, the beam lamp, the lock, the central lock and the fog lamp, respectively.
3. The proposed QLF declined by 586.872, 38.3878, 31.8735, 191.2442, 65.3918 for the scanners, the fund lamp, the lock, the central lock and the fog lamp at a 15% reduction rate.

4. That means that whenever the company seeks to reduce the deviation from the specifications, it will be able to achieve significant savings, such as achieved by reducing deviations by 5%, 10% and 15%, which amounted to 3300644.166 dinars, and 6601289.738 dinars, and 9901934.202 dinars, respectively.

Conclusion

The study focused on the problem of low quality and high number of defective products as well as multiple defects in the General Company for the automotive industry. in order to Helps to improve production processes by eliminating many problems, including the emergence of many product defects, through the use of advanced technology to improve its operations. Increase the company's ability to compete in the local markets by improving the quality of its operations and reducing the cost of quality resulting from the productive units produced. the results of research are reduce the percentage of defects to reach them and to detect deviations in the outputs of the production process was designed program using the language (Microsoft Visual Studio 2015) for the operation of (Taguchi technology).

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