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SINTHESIS ON THEORIES OF QUALITY MANAGEMENT WITH APPLICATION IN WIRING INDUSTRY

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Abstract

Quality management in the electrical wiring industry is a complex issue. The paper presents a brief literature review in complex terms related to the quality management, the methods which can be used towards continuous improvement, first as quality management in its whole concept, than as quality management in the wiring industry. The base in quality in wiring industry are the test in the Laboratory and verifications in the production line. Finally, is focusing on the electrical resistance which on several tests was to high exceeding the maximum value. Due to this, a corrective action must be implemented.

Key words: Quality management, QFD, Lean Six Sigma, 5S method, Wiring industry, Electrical resistance

1. News basis investigated and the current state of knowledge

Quality is primarily a matter of education because only educated people can act professionally and can do good things from first time and every time. Quality is, secondly, a culture issue because it allows understanding the need for quality and knowing what is good in the global plenary. Last but not least, quality is a problem of behavior, because through the achievement of good products it is strongly involved in activity, the resumption of actions that have unfolded, the return to the insufficiently clarified aspect and the tenacity in the work [10].

Quality management systems are one of the most effective tools for companies to increase competitiveness. This issue have been studied for a long time since Dr. Edward Deming and Dr. Joseph Juran have started their studies and practical implementation of quality management and quality thinking in the companies, 60 years ago [11]. This topic is still very important in nowadays because quality management systems are still effective. If we look at some recent publications than topical issues are: motives, benefits and strategic results from ISO 9001 and impact on perception of customers [2], firms implementing ISO 9000 [5], comparison of ISO 9000 in manufacturing and service organizations [14], ISO 9001 certification forecasting models [13], quality thinking and system thinking in quality management [3,4] and components of successful total quality management [15]. In context of new technologies development, there is a constant need for quality methods and engaging for continuous improvement, assuring the company's success in the future.

Regarding to the multiplicity of different characteristics of similar products today's competitive industrial world, the selection of the most suitable characteristics for the customer satisfaction is crucially important. The "voice" of the customer is a vital element in this process [8].

Along with the techniques of the classical tools, in the quality management it is used a series of modern instruments taken from the field of creativity and management that does not substitute the classical ones, on the contrary to obtain spontaneous results it is recommended to use both [9].

2. Materials and Methods

The paper is part of a complex project to be carried out with several coworkers from the wiring company's metrology laboratory, the most important issue is meeting the client's request. The project is about implementing a quality method toward continuous improvement with focus on clients "voice". Thus, the

paper makes a synthesis of the most important studies and articles that deepen the complex issues of quality management. The research methodology is based on prior studies in quality management fields.

Quality is a notion that besides being in constant change, it must be achieved by organizations. In order to do it, first and foremost the management of the company should be committed to quality. The Chartered Quality Institute believes that the quality implementation comes down to these things: strong governance to define the organization's aims and translate them into action, robust systems of assurance to make sure things stay on track and a culture of improvement to keep getting better.

The project, which is part of this work, wants to implement solutions related to none quality in departments of a company, which are related with customers, have direct link with the customers or they are producing for them.

Thus, the purpose of this article is to synthesize the most important methods to obtain, maintain and improve quality in a company in order to raise customer satisfaction, encourage employees to contribute, so they will have confidence in their work and within the organizations in which they operate, raise performance of the company by continuous improvement at large scale and continuous improvement by waste elimination.

For this purpose it was identified the most important and recent studies related to quality methods. We believe that the complexity of the data contained in bibliographic references can be extremely overwhelming because, in order to understand and identify structurally quality methods, information is needed from many parts. The research methodology was one of the syntheses of the extremely generous information provided by these totally different sources.

The paper concludes, however, the most important aspects of each field under consideration.

3. Types of quality improving methods analyzed:

3.1. QFD (Quality Function Deployment)

Quality Function Deployment (QFD) is a methodology to translate customer requirements into the final product or service characteristics [1]. The first matrix used in the QFD methodology is the House of Quality which translates the customer's voice into design requirements in order to obtain specific target values.

There were many studies on the issue of the QFD and authors have studied in die early 2000 what are the benefits of QFD and what are the weakness of the method. Fiorenzo Franceschini [6] set as list in his book in 2001 with the problems that appeared as using the QFD method. The first is the cultural barriers that thwart the creation of project teams able to use QFD. However in 2015 Marithan Davide mentions as a weakness the lack of information and knowledge how to apply the QFD [7].The second is the lack of friendly tools able to reduce the training time [6]. On the other hand, Marithan Davide finds that it is as an interpretation of market data that seems to be difficult, how should one identify and organize [7]. And the third is the exponential growth of managerial difficulties connected with the increased size of design projects. And finally, the management of designs of large size, which involves both a high number of customer requirements and a high number of technical characteristics [6]. This difficulty is found in the book of Marithan Davide as organizational difficulties and the lack of "Longitudinal studies" [7]. So we can conclude that the management and the organizational difficulties haven't got a solution which is a matter of senior management.

However the benefits of using QFD are more than twice as the lacks and they were mentioned after studies by Davide Marithan in 2015:

- helps in reaching compromises between customer requirements and what the company (organisation) is able to produce; it can also help in finding new opportunities and in defining strategies to increase profits and market share;
- identifies the check points forgemba, a Japanese word that refers to the place where the source information can be learned;
- facilitates or, rather, requires a strong inter-functional involvement between different offices, for example the sales department, technical department, engineering department, quality control and production department;
- allows for a reduction in start up problems;
- definitely enhances analysis concerning market, customers and competitors;
- clarifies check points, determining a reduction in development time (lead time) and better project planning and timing;
- through its matrix calculation flow it can fix targets from design to production; it can be stated that quality of the process is built "upstream" [7].

3.2. 5S Method

The 5S method when is implemented creates and maintains an organized, clean and efficient workplace. This method is about 5 S-word which helps organizing the employs:

- Sort -Sorts and separates elements which are necessary and unnecessary;
- Shine - Clean the workplace and equipment periodically, so that anyone can identify their defects;
- Straighten-Organize the necessary elements in the right place to create an optimal and effective environment. It clearly identifies the places for each element so that anyone can find and return them once the task has been fulfilled;
- Standardise- Making standards and applying them;

- Sustain- Maintains standards and improves continuously, every day.

5S refers to the organization's workplace and could give a solid foundation for many organizations that want a quality towards continuous improvement and have remarkable results.

3.3. Lean Six Sigma (LSS)

Is a method that combines the statistical quality control and design of experiments in a general framework towards continuous improvement. Lean Six Sigma (LSS) has been seen as a business improvement methodology by integrating two distinctive management philosophies: Lean and Six-sigma who are complementing each other in order to improve enterprises processes and results. This integration has been achieved blending their methods and principles by using the DMAIC (define, measure, analyze, improve, control) cycle as the conjoint continuous improvement framework and conjointly making efforts to reduce production defects and process variability along with process simplification and standardization and waste reduction [16] .

3.4. Visual Management

Visual management means the ability to understand the state of a production area in 5 minutes or less, through a simple observation, without using the computer and without talking to anyone.

By visual management, you are signaling the attainment of conditions that can cause an abnormal situation, so that it is possible to apply a corrective action on time [12].

It is a functioning philosophy based on quick information absorption to make effective decisions. In other words, this method means: organization, standardization, communication.

4. Quality methods in wiring production

After the synthesis made on quality aspects in paragraph 3, we can conclude how important is a quality method to implement in company, so the next phase is to implement one or more methods in the company were this project is implemented.

The importance of quality is based on the Laboratory results and on the results given by the measuring devices attached to the machineries.

4.1. Production control

Tests are made on all products (100%), they do not damage the product, only check if it has been done correctly and is in accordance with the customer's requests. These are made by devices that are:

1. Attached to the machine itself:

- here we find the device that measures the diameter of the conductors and is attached to the extruder;
- the device that verifies that extrusion is intact and continuous, without missing material or holes, which is attached to the water bath of the extruder;
- the device that checks the diameter of the sheath and is attached to the extruder that produces the mantle.

2. Appliances near the workstation

The machine that tests whether the current is passing through the cable to normal parameters and tests the integrity of the plug is not pierced by copper strips that have not been accidentally caught in the core or bush.

4.2. Tests in the laboratory

In the laboratory wires are tested continuously. These tests will destroy the wire or damage them, so as they will no longer be used in production. Thus, these tests are made at the beginning of productions and at the end. There are standard tests or special tests. All of them are meant to assure the client that he is getting the best product.

At every beginning of the test a Testing Bulletin is made. This paper contents every tests that it's been made on that type of wire.

The content of the tests is presented below.

4.2.1. Electrical resistance

Electrical resistance is a physical magnitude that expresses the property of an electrical conductor to resist passing through it.

In this test, the sample is made up of a 5 m cable, according to standard procedure, the two ends of the 10 cm sheath are stripped, then the conductors are stripped so that the copper end is 3 cm. These ends are serrated as follows: at one end, they fix the copper from all the conductors, and at the other end only copper is threaded from a wire.

Connect the DC power supply to the bridge in the decade (top of the appliance).

The bridge is graduated with the numbers 1000,100,10,0.1. Here the levers are rotated in order to enter the value to be used to determine the electrical resistance. Then it is set the value by which the galvanometer has detected it. It is known that the resistance per km is 13.3 Ω / km, than it is multiplied by 5 (5m of cable) that is equally 66.5. This value is the one that is inserted into the appliance and the pushing lever is pushed in. At this point, the needle on the galvanometer is spotted to the left or to the right side. Moving to the left means that the value set on the box is too high. If the galvanometer needle moves to the right side means that the value set on the box is too small. It is set until its needle indicates "0". This is the ideal value. In order to obtain the resistance it must be divided by 5.

4.2.2 Test voltage on cable and conductor

This device measures the voltage on the cable or the conductor in the wet or dry environment. It begins with fixing the 2 unshielded ends of the cut wire 5 m

in advance, according to standard procedure. It is set the device to 200 kV. Strain tension is applied with duration of 1 minute according to standard procedure. If the mantle has not been pierced during this time, it results that it is correct according to the checks.

For wet checking, testing is done between cable and water.

4.2.3. Insulation resistance at 90 ° C

This resistance is measured with a megaohmmether to which an aperture vessel is attached.

Measurements are made depending on the water temperature. As required, this test is performed at 90°C. The length of the cable is also 5 m. The cable collar is inserted into the water. Only the copper sheets must be left outside. The end of the wire is clamped with the clamp of the device (colorless) and the other end of the megaohmmeter is drawn to the water.

Attempts at all temperatures are the same. Once the water has reached the desired ranges, the cable is left in the constant water for 1h. After 1 hour, the insulation resistance is read for 1minute. The applied voltage is between 80-500V.

4.2.4. Radial thickness of the sheath or insulation

The radial thickness is measured with the apparatus called the Profile Projector. To be able to measure, an insulation sample is required (the test is done for all three colors blue, brown or green / yellow). This is a 1mm thick insulation tube and the thickness of the wall is measured in 6 different places.

The insulation tube is placed on the machine's table, and then the table is rotated manually to 120°. The average value of the measurements shall be greater than or equal to the nominal value which is given.

After making the measurements and filling the Bulletins the next step is to analyze results. The Bulletins have shown that the parts were conformable, only with one issue, the electrical resistance was too high.

In this particular situation it was taken samples of brown conductors for the electrical resistance test. The maximum value 19.5 Ω/km is provided by the Standard for electrical wires. In other words if a conductor is exceeding the maximum value, it means that the opposition is very high, that could generate overheating, and if the cable is inserted into the socket this can be a cause for short circuit. The electrical resistance of the power supply cables should be as small as possible.

For analyze it was taken 10 samples of a 3G1,5 cable type, made in production. After testing them, the electrical resistance revealed to be on some parts very good and on other parts too high.

Results in the diagram (Fig. 1) reveals that the fifth part has a very low electrical resistance, that means this piece is the best from this test point of view. The forth and the eighth have it very high, exceeding the maximum value. As the tests shown they have: the forth 19.62 Ω/km and the eighth 19.7 Ω/km.

This values are exceeding the maximum value of 19.5 Ω/km, that means that they can't be sold, they are no supportable for usage.

The biggest problem now is that the pieces are selected from different flows, and we must conclude that there is a possibility that in the work flow can be at least one piece that can be inconsistent.

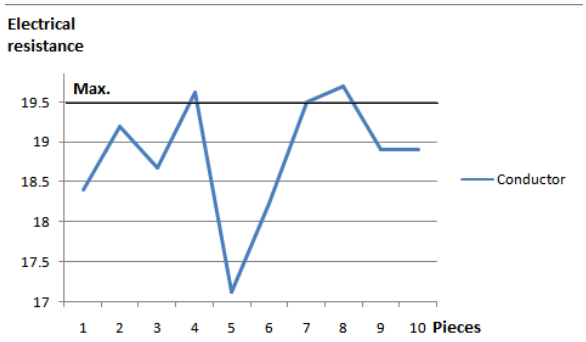

Fig. 1: The electrical resistance on 10 pieces

Because more than one part has exceeded the maximum value there must be a corrective action taken. For this purpose we made a brainstorming activity to list all the possibilities which could cause this problem.

5. Solutions for the high value of electrical resistance

5.1. Electrical resistance on raw material

First the electrical resistance of the copper threads must be verified. The company is achieving the copper threads as raw material and therefore the electrical resistance is tested at every delivery. So it was concluded that the copper thread was in order. The electrical resistance was between 12.00 and 13.00 Ω/km which means that is conclude.

5.2. Work in production

Second was the analyze in the production flow, by focusing on the workers, how they are working. It was noticed that the worker tends to pull the cable in order to ease the work.

It can be seen in the diagram, that this high value does not happen every time, it is occasional.

After talking with the workers in the shifts it was decided to test a wire for electrical resistance which was not pulled. The test revealed that the electrical resistance was lower, only 17.7 Ω/km.

After finding the problem it was decided to apply visual management. This kind of management can be understood by every worker.

It was made a plasstifyed sheet of paper with this information and a picture with the values of the electrical resistance which was slicked on the machine, so every worker from the 3 shifts can easily see.

Workers were informed about the problem in a short mitting in the factory presenting what was the issue and the solution.

6. Conclusion

Nowadays increased productivity and a permanent improvement of product quality require to develop new technologies or to increase the performances of the already existing technologies and processes.

Quality is about making companies perform for their customers. This can begin from improving products or services, systems and processes. This improvement must be researched, implemented, than again tested if brings changes into better, all this to make sure that the whole organization is fit and effective.

Customers are the targeted group for the majority of companies, but the other part of people like, suppliers, employees, and members of our wider society are important too. A healthy quality management in the organization means to know who stakeholders are, understanding their needs, accomplishing them, or even better, exceeding expectations, at present and in the future.

Organization should care about quality because is the way to survive and thrive. A good quality management can enlarge the organization's reputation, increase the brand's name, protect the company against risks of none quality or bad image, it should increase its efficiency for long term, it will definitely boost its profits and therefore its position on the market will increase and the Company will keep on growing.

We conclude for the next step to implement the QFD in the organization as a project toward continuous improvement, with focus on the client's request, for filling them and after exceeding them.

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