

Improving the quality of the mechanical systems by specific methods in connection with a commercial entity

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Abstract. This paper aims is improving the quality of mechanical systems, using specific methods. In the first part of the paper, we will identify the causes of non-quality, using ISCHIKAWA diagram. Based on data collected from economic entity studied, using PARETO chart, we will identify the main action. In the second part of the paper, we will implement the specific quality improvement methods for mechanical systems, previously identified. In the last part of the paper, based on new data collected from economic entity, it will make a statistical prediction quality for the next period.

1 Introduction

Product quality is the primary factor in the development of any organization, hence the importance of a quality management system. [1]

The concept of quality has evolved over the years, due to the industrial and information society development. In time, quality evolves from quality control, to quality assurance and then to total quality, taking into account both the social component (staff involvement, participation) and economic component (the organization's image, reducing quality costs).

The analysed company MGC INTERNATIONAL INVESTMENTS Ltd. has more than 1600 employees in several factories in Romania, with a production of 300 tons of finished product per week. The company produces and sales canned vegetables and fruit, canned meat and mixed.

The main objectives of the study are set out in the quality policy statement of the general manager: increasing the number of customers in the European market, reducing the number of complaints by 40% over the previous year and reducing production costs.

This study is significant because the analyzed company has the most important role in the labor market in the area.

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2 Sampling data

The Company has proposed implementing food safety management system in accordance with the requirements of SR EN ISO 22000/2005, which is described in the Handbook of Food Safety Management System (HFSMS).

Food Safety Management System (FSMS) described in this handbook sets out measures to demonstrate the application of the requirements of the aforementioned standard and the performance and capability of the organization in terms of providing consistent products with improved safety for consumers.

To operate legally and in good condition and meet the wishes of the beneficiaries in terms of quality of the finished product, proving the implementation of all laws and regulations in force, both in Romania and the European Union, the company has implemented the HACCP (Hazard Analysis and Critical Control Points) system, with the organizational procedures and implemented by this system by granting decisions by all team member.

They established checkpoints (CP) and critical control points (CCP) and were implemented proceedings and recording of data obtained at their level. This data is collected from the measuring and control instruments (AMC) and to the accompanying documents. All data is used to determine if it violates the law (temperature, microbiological parameters and physicochemical parameters). This data is archived electronically and on paper due to the possibility of establishing traceability of a finished product.

In developing the concepts of quality control, and quality assurance and subsequent total quality control were gradually developed a number of methods, tools and techniques that contribute to quality improvement. [2]

As no improvement action should not be employed without relying on data, this paper proposes a study of the relationship between cause and effect that they produce, and finding solutions to problems based on causes that led to negative effects on MGC INTERNATIONAL INVESTMENTS Ltd.

This study will be highlighted by cause and effect diagram (Ishikawa), shown in Figure 1 where the causes of non-complying products for human consumption correspond 6M: environment, labor, measurement, management, machinery, materials. [4]

The main advantage of Ishikawa diagram is highlights the 6 groups all causes of non-quality products. Another advantage is that for each group may consult various departments within the company. Main disadvantage is relatively long duration for proper preparation of this diagram.

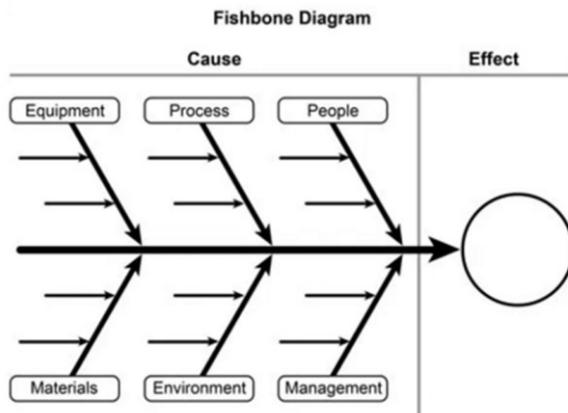


Fig. 1. Ishikawa Diagram

The analysis was conducted by quantifying the nonconformity products and analyzing the causes of non-compliant products for a period of 30 days.

Thus, resulting the following histograms for the non-compliant products in groups. It should be noted that these data were obtained from the department for products checking inside the factory prior to marketing.

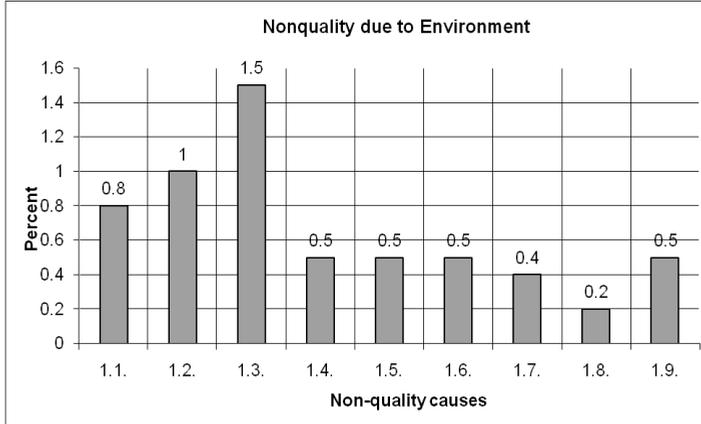


Fig. 2. Non-quality due to environment

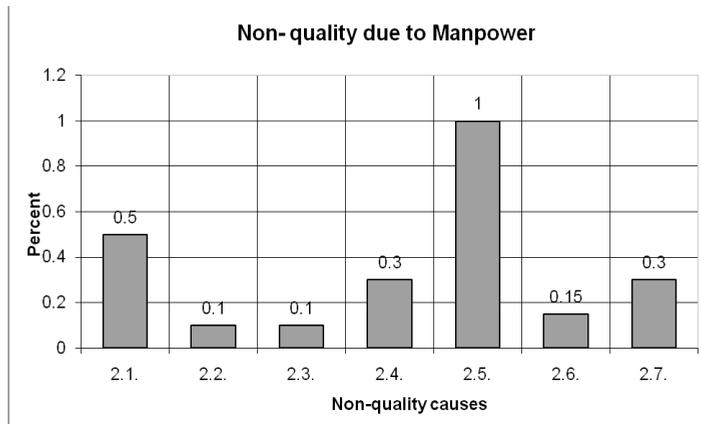


Fig. 3. Non-quality due to manpower

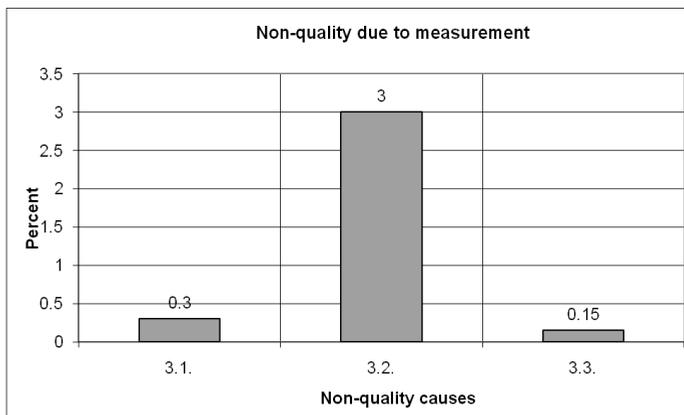


Fig. 4. Non-quality due to measurement



Fig. 5. Non-quality due to Management

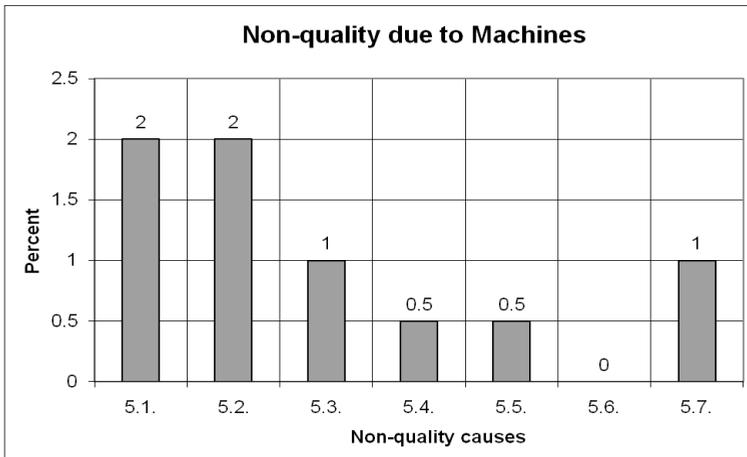


Fig. 6. Non-quality due to Machines

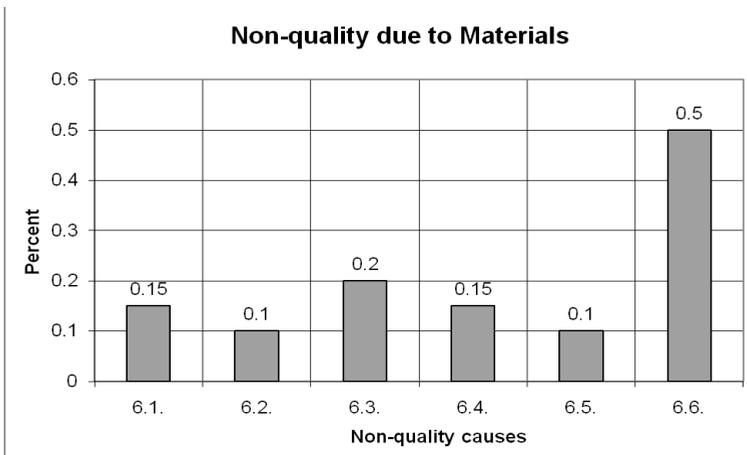


Fig. 7. Non-quality due to Materials

The table below highlights the percentages of influence of all causes of non-conformity of the finished product:

Table 1. Cases of non-conformity according to Ishikawa diagram

No.	Cause	Subcauses	Non-conformity [%]
1.	1. Environment	1.1. Lighting	0,8
2.		1.2. Ventilation	1
3.		1.3. Technical suspended routes	1,5
4.		1.4. Cleanliness	0,5
5.		1.5. Disinfection	0,5
6.		1.6. Equipment sanitation	0,5
7.		1.7. Staff hygiene	0,4
8.		1.8. Protection equipment	0,2
9.		1.9. Bacteria removal system	0,5
10.	2. Manpower	2.1. Good practices	0,5
11.		2.2. Staff training in the workplace	0,1
12.		2.3. Instructing	0,1
13.		2.4. Lack of financial motivation	0,3
14.		2.5. Training for equipment handling	1
15.		2.6. Working program	0,15
16.		2.7. Operators health check	0,3
17.	3. Measurement	3.1. Installations to measure the weight of raw materials, finished products	0,3
18.		3.2. Temperature measurement system	3
19.		3.3. Optimization of packaging - sensors	0,15
20.	4. Management	4.1. PO and PL procedures	0,5
21.		4.2. Employees information system - production stage	0,25
22.		4.3. Finished products transportation system	0,3
23.		4.4. Contracts with raw material suppliers	0,2
24.		4.5. Product sale system	0,2
25.		4.6. Marketing system	0,5
26.	5. Machines	5.1. Harvesters	2
27.		5.2. Transport	2
28.		5.3. Washing and sorting machine	1
29.		5.4. Processing	0,5
30.		5.5. Weighing and packaging machines	0,5
31.		5.6. Vacuum machines	0
32.		5.7. Maintenance	1
33.	6. Materials	6.1. Raw material suppliers database	0,15
34.		6.2. Providers Classification by quality / price	0,1
35.		6.3. Classification of suppliers based on timeliness of delivery	0,2
36.		6.4. Linking the two classifications	0,15
37.		6.5. Third party audits	0,1
38.		6.6. Archiving according raw material documents	0,5

3 Conclusions

Unable to act cumulatively to all causes of non-quality or because of organizational or financial reasons, it is necessary to decrease significantly the percentage of not complying products with minimum effort. Thus, actions have yielded from all points of view.

To know in detail this phenomenon it must be applied another quality analysis which is called "Pareto Analysis".

Pareto analysis is a statistical technique for classifying tasks small in number but with significant effect. It is based on the Pareto principle (also known as the 80/20 rule), which states that 20% of resources generates 80% of total labor, or in terms of quality improvement, most of the problems (80%) have several key causes (20%). [3]

Pareto chart helps management interventions methodically through action plans built around the major causes of emerged problems, by being a strongly visually oriented, to make the decision. It is a tool for qualitative analysis because it focuses on process parameters in terms of frequency. Defined parameters can be events, errors, features, etc.

Of the 38 non-quality causes 20% representing 7.4 causes. The following eight causes were chosen as representative:

Table 2. Cases of non-conformity according to Pareto Analysis

No.	Cause	Subcause	Non-conformity [%]
1	1.Environment	1.2. Ventilation	1
2		1.3. Technical suspended routes	1,5
3	2.Manpower	2.5. Equipment handling training	1
4	3.Measurment	3.2. Temperature measurement system	3
8	5.Machines	5.1. Harvesters	2
9		5.2. Transport	2
10		5.3. Washing and sorting	1
11		5.4. Maintenance	1

After corrective actions listed above causes and establish new percentage of non-compliant products, where they exist we can start the depreciation of these corrective actions.

Using specific programs, we can predict when they will recoup their investments and especially what are the company's gross earnings. It should be noted that these calculations have real value only if it does not change the parameters, for example the average sales prices of products and raw materials or other taxes, contributions and excises.

For correct predictions, we suggest the use of higher mathematics regression curves with equal residuals and standard errors that tend to 1. These curves we aim to generate with the soft CurveExpert 1.4 after taking data from the company.

References

1. Bernard Froman, *Managementul Calitatii*, 77, (Ed. Tehnica, Bucuresti, 1998)
2. Henri Mitonneau, *O noua orientare in Managementul Calitatii*, 12, (Ed. Tehnica, Bucuresti, 1998)
3. Arthur L.J., *Rapid Evolutionary Development – Requirements, Prototyping & Software Creation*, (Ed. John Wiley&Sons, 2011)
4. Boca Dana, *Bazele managementului calității în afaceri*, (Ed. Risoprint, 2013)