Review of Management and Economic Engineering
Vol. 20, No. 4(82), December 2021, p. 328 - 342, ISSN (print): 1583-624X, ISSN (online): 2360-2155

TOOLS USED TO IMPROVE QUALITY MANAGEMENT

Grațiela Dana BOCA[1*], Francesco GENOVESE[2]

1 *Technical University of Cluj-Napoca, Faculty of Sciences, Romania, gratiela.boca@econ.utcluj.ro*
2 *SAFE, Università degli Studi della Basilicata, Italy, francesco.genovese@unibas.it*
* *Correspondence: gratiela.boca@econ.utcluj.ro*

Abstract: An action plan to improve competitiveness is through productivity. In reality, productivity must be defined as an efficiency indicator that correlates the amount of resources used with the amount of production obtained. The company does not currently have an action plan that will allow it to measure, to improve the company's management in order to optimize its production. The design of an action plan to improve productivity allows for improved decision-making capacity regarding the company's management control. This will reduce the occurrence of production losses, reduce operating costs, and select an appropriate raw material, which will influence better operational stability, increase productivity and competitiveness. This study reflects the situation of the company and is aware of possible errors in the production process and how to eliminate or reduce unproductive events. For a better analysis, the cause-effect diagram was made in order to know clearly and objectively the defects discovered in the production process, taking into account the non-productive elements.

Keywords quality, ISHIKAWA diagram, fish bone diagram, 5M's, improvement

1 INTRODUCTION

The problem of quality is an essential one in the evolution of things and phenomena and has been approached for a long time by specialists in different fields of activity. Even greater problems are disputed in the area of quality levels that cannot be generalized and unanimously accepted by everyone.

Experience has shown that the existence of organizations is the result of maintaining a state of balance. In this context, organizations focus their strategies so that all efforts are located on the customer, on meeting their requirements and needs (Tomescu, 2008).

The stake of the success of the quality approach has made over time to look for means, tools, techniques, methods, principles, norms through which the quality objectives become paramount until the realization of all needs and requirements in the form of a product or service that leads to satisfaction and customer delight.

The realization of high quality products and services at low costs has become an indispensable condition for obtaining high productivity and efficiency rates. Only companies that work for the quality of their products and services survive in the market and thrive. At present, price has lost some relevance in terms of quality. There are a growing number of consumers who prefer to pay more, if quality justifies it. For a product to be of quality, it must have properties capable of satisfying the needs of the consumer.

In order to obtain quality in the production system, inspection or control alone is not enough. Management is essential, which involves: planning, implementing, controlling and improving it from the strategic to the operational levels of organizations.

By offering quality products, the company will consolidate its strategic orientation on the market and will obtain competitive advantages (Szymon et al. 2021).

We note that today quality is no longer a concern not only of organizations, but also of each individual, becoming an element of education, culture which allows a better understanding of its need and knowledge of what is best in the world. Quality is also a problem of behavior that involves insistence on activity, resumption, return, tenacity at work. The current guidelines in defining quality are towards the product, process, costs and user. Each of these guidelines specifically defines the new trend of Industry 4.0 and the harmonization of quality with the concept of Quality 4 (Alex Gray, 2016).

2 LITERATURE REVIEW

A tool used to improve quality is the Fishbone diagram, also known as the Ishikawa Diagram, is a visual problem-solving technique invented by Kaoru Ishikawa, a Japanese quality control expert. In the case of production processes, the Fishbone Diagram is an effective technique for analyzing the causes.

The diagram helps people identify the potential causes of a problem and is a very useful brainstorming tool when problem solving is blocked (Angie Lin Boyer, 2019). This tool has been applied to improve quality management and has been used in various fields to obtain solutions to identified problems.

Ilie and Ciocoiu (2010), mention in their research that the fish bone diagram allows the determination of risk management, secondary and main causes, categories of causes, also allowing the structuring of treatment measures on areas of vulnerability, precisely focused on causes.

Ecobici (2017) also mentions in his research that the manifestation of risk leads to a difficult situation that the management of the organization should analyze and find viable solutions to overcome by using the same tool.

Fishbone diagrams also have been widely used in health care for cause and effect analysis related to patient safety by Byers and White (2004), G. Gartlehner et al. (2017)

Cheng et al. (2019) presents the application of a fishbone sequential diagram in air traffic management also as a key connection between safety occurrence analysis methodology and incident data reporting approaches.

Luo et al. (2018) apply successfully the fishbone diagram and risk matrix analysis method in safety assessment of natural gas spherical tank.

James et al.(2017) in automotive industry and the maintenance and failures and adaptation of method for evaluating quality management processes (Gartlehner, 2017).

Coccia (2020) explore and analyze the source and evolution of innovation the study shows the driving forces such as high investment in R&D and in general of new technology is represented with fishbone diagram for the technological analysis.

A.C. Yurin et al (2018) in their paper describes an approach for the automated development of rule-based knowledge bases by transforming fishbone diagrams. The approach is based on the identification and extraction of structural cause-effect elements of fishbone diagrams and their transformation into the elements of a target knowledge representation language, in particular.

Fabiś- Domagała (2017), study the analysis of a pump by means of the Ishikawa Diagram proved that it can be a useful tool in identifying relationships between cause and effect for the during pump malfunction or its damage. The paper presents an identification of potential causes and effects of failures of a coolant pump for internal combustion engines.

Ishikawa's quality improvement tools have been used also to analyze the defects. One of the fundamental objectives of organization is to improve the quality of products.

In order to establish the directions of action in order to achieve this objective, the main causes that did not ensure customer satisfaction were analyzed.

Cheng et al. (2019) applied the fish bone diagram in air traffic to investigate management incidents. The diagram is useful for classifying the causes of failure but also the potential to establish temporal dependencies between causes. Prevention reduces the possibility of the non-compliant product reaching the customer and will also increase productivity and support continuous quality improvement.

Fidiyanti and Susanto (2018) aimed at managing the amount of defective packaging of capsule products. Data for this research were obtained for defective packaging through interviews with those in the quality control department, the capsule products department and the operator. They used the fishbone diagram to identify the cause of the defect and provide recommendations on improvements to the production process.

Wahab et al.(2014) apply the diagram for another field in human resources to identify solutions for improvement of perception and human productivity. Utari and Nasri (2021) observed in their research that the work environment becomes one of the motivations for someone to work.

3 CASE STUDY

SC Ridorail is today the only manufacturer of curtain rods that offers real technological innovations. The products are customized for PVC, aluminum and wood windows and doors, windows, wall-to-wall windows, recessed or applied roller windows.

The main activity of the company is the production of wooden and metal galleries and curtains, and as a secondary activity the company also produces wooden games for children.

The company is constantly concerned with improving its business, diversifying the product range and making investments in new technologies. The main objective is customer satisfaction by offering quality products and on-time delivery of orders. The company is constantly looking to optimize processes and reduce costs without affecting the quality of products. At the same time it adapts to changes in customer orders, without neglecting the delivery times of products

The company does not currently have an action plan that will allow it to measure quality, to improve the company's management in order to optimize its production. The design of an action plan to improve productivity allows for improved decision-making capacity regarding the company's management control. This will reduce the occurrence of production losses, reduce operating costs, and select an appropriate raw material, which will influence better operational stability, increase productivity and competitiveness.

This study reflects the situation of the company and is aware of possible errors in the production process and how to eliminate or reduce unproductive events. For a better analysis, the cause-effect diagram was made in order to know clearly and objectively the defects discovered in the production process, taking into account the non-productive elements.

4 METHOD AND RESEARCH

The survey was carried out on the production staff of the company SC Ridorail in order to know the current situation of the company regarding the approach to quality management, a survey was applied.

This was done by completing the individual questionnaires. The sample size was 100 employees from production process from which 81 people are directly involved in production, and 9 people are in the category of technical staff.

The employees who participated in the survey carry out activities in all phases of work.

The questionnaire had closed questions with the possibility to select a variant from the Likert scale used from 1 to 3, where 1 represents = "excellent" and 3 = "bad".

The survey was structure in four parts with eight items:

Part 1: production process

I1: identify respondent's opinion regarding the efficiency of production process;

I2: identify the respondent's perception about machine performance;

I3: the machine good working condition;

Part 2: damage and defects frequency

I4: establish the frequency of defects/ failures;

I5: identify the check point from different stages of production process;

I6: identify the measures apply to avoid defects;

Part 3: quality tools used in production process

I7: identify the quality tools used in production process;

Part 4: measure employees/staff perception regarding the quality measures in production process

I8: identify employees' opinion about quality management.

After applying the survey, and identify the problems, a fishbone diagram were used also for each problem to establish the solutions.

The technique used was brainstorming.

A brainstorming session was organized to create the fish bone diagram and establish the internal and external factors.

The fishbone diagram tool was used to identify the causes of the problems which influence the SC Ridorail activities.

To help to identify the causes each team member completes the fishbone diagram to better understand the causes of the event.

A group of seven people was formed: the head of production, the heads of workshops, the purchasing manager, the stock manager, the order manager, the administrator and two workers.

The elaborated graph identified the main causes of the studied problem.

These are the causes or aspects specific to each category that was present in the analysis because it has a direct or indirect relationship.

5 RESULTS

Using the data obtain from the respondents it was possible to identify various aspects were analyzed in terms of employees' opinion and knowledge about quality management.

The first part of survey was focus on the efficiency of the production process efficiency and performance of machines.

As a result, the survey carried out on the production staff provides that 60% of those surveyed consider that the efficiency of the process is achieved in an excellent way (Figure 1).

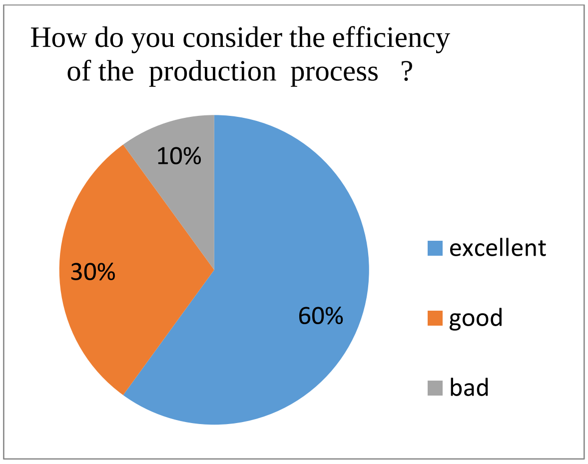

Figure 1. Respondents perception about efficiency of the production process

30 % percent of respondents consider that efficiency of the production process it is good.

The staffs who considers the efficiency of the process in terms of good, is due to the fact that they are more familiar and in full contact with the machines in the production process and they know that sometimes there are unpredictable defects and failures.

Only a percent of 10% of respondents consider that production process efficiency it is poor, due to the fact that they have focused on defects on what should be improved to make it good.

Regarding the performance of the machines in the production process from Figure 2, a percent of 20% of respondents consider that the machine works in the best way, ie a percent of 20% of respondents think that it behaves well. 60% of the respondents consider that the performance of the equipment is poor, due to the moral and technical wear and tear overcome by the new technologies.

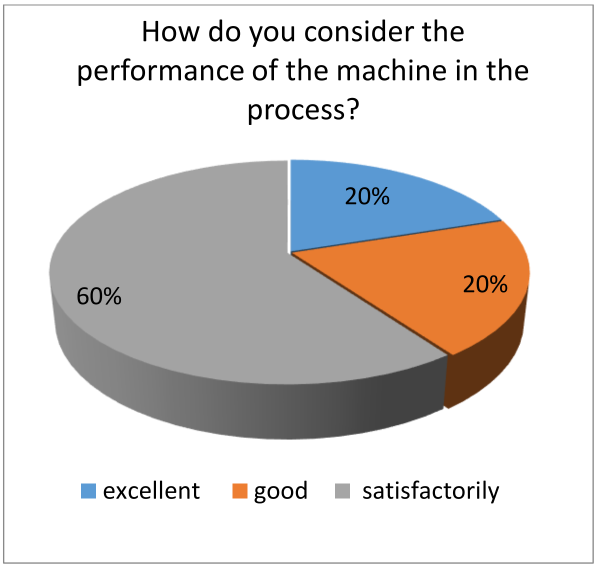

Figure 2. Respondent's perception regarding the machine performance

This signals to us that during the production process the quality leaves much to be desired, or the quality check is not performed at every stage of the technological process to ensure the final quality.

Based on the answers, the management team will be able to identify solutions to improve quality. Regarding machinery and machines, in addition to performance and efficiency, another question was asked to identify whether they are used correctly by the working staff.

A 60% percent from respondents consider that they used the machinery correctly and only a 40% percent consider that only in some cases they used the machines in the processing process are offered in good parameters, no one thinks that machines park it is not used correctly.

The second part of survey was focused on failures, damages and defects from production process (Figure 3).

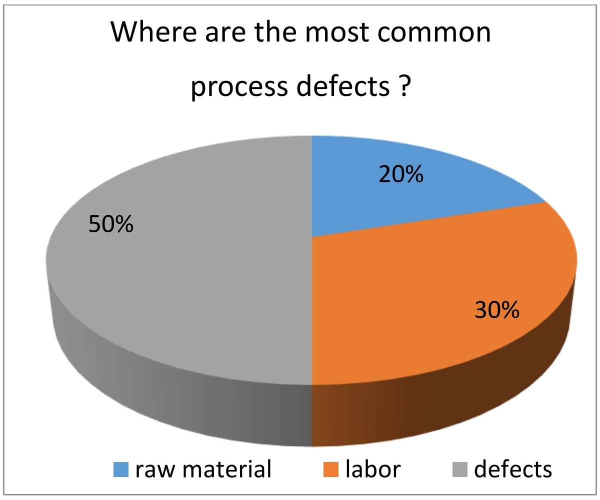

Figure 3. Frequency of defects during the production process

In relation to this question, 20% of respondents consider that the most common process defects are due to the quality of raw materials used, 30% consider that process defects are due to labor, how the staff operate the machine or perform a task, and most 50% believe that the most common defects in the production process are due to mechanical defects.

SC Ridorail, as an organization, has a preventive maintenance plan, but it is not implemented. The applied maintenance is of the corrective type, the causes for a solution are sought, because the repairs take a long time and delay the technological process. It should be noted that all the causes that generate defects in this process have to do with the equipment, because it is observed that there is the main cause of defects in the production process.

To be sure that quality it is verifies and maintains in all stages of production process the next survey structure part was to identify if there are special protocols to verify it (Figure 4). A 15% percent of respondents believe that there are checkpoints at all stages of the production process.

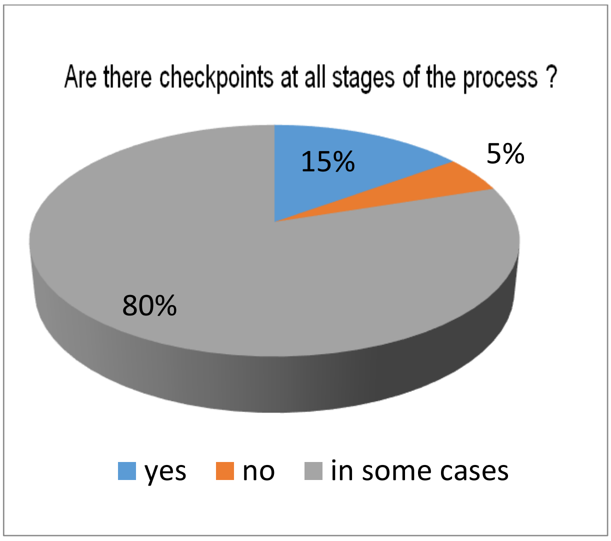

Figure 4. How production process quality it is verify

5 % percent of respondents say that there are no checkpoints at all stages of the process and 80% believe that there are checkpoints only in some stages of the process.

Regarding the measures used to avoid defects in the production process (Figure 5) 25% percent of respondents consider that they are appropriate.

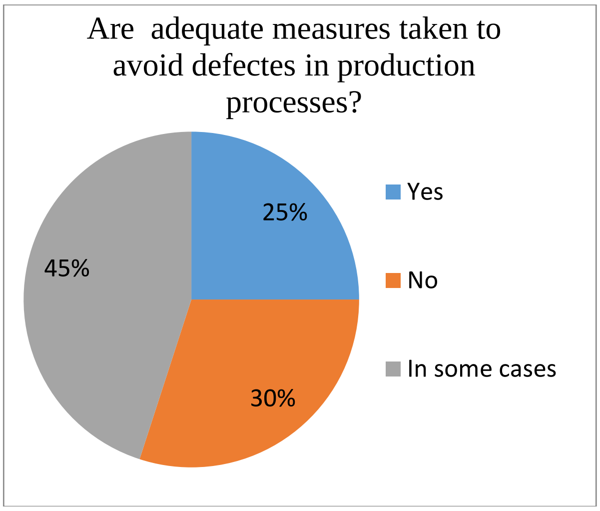

Figure 5. Measures to avoid defects in production process

30% consider that measures which are taken no appropriate and 45% of respondents consider that only in some cases appropriate measures are taken to avoid process defects.

It is necessary to emphasize that there are no standard measures or those provided by the company to reduce defects in the production process, so most respondents are not satisfied with these measures that were adopted through the experience of workers and by observing workers and only a few that are provided due to the controls that are made in the process.

The survey also in the last part establishes the quality for tools applied in the technological process Figure 6. 20% of respondents consider that appropriate quality tools are applied to the process, 25% consider that in some cases 55% consider that quality tools are not appropriate.

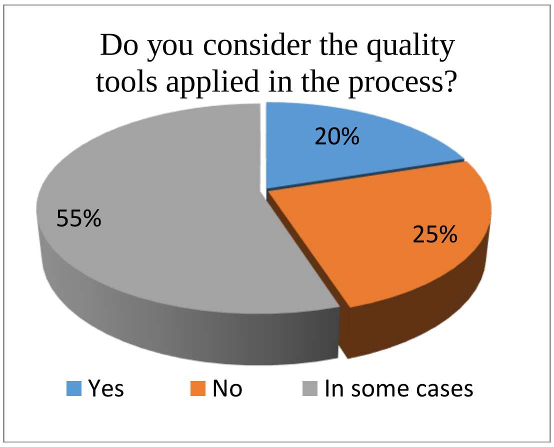

Figure 6. Tools used to measure quality in production process

The organization bases its quality tools on what the customer wants. These tools are observation, inspection and the different types of control that are performed in the process to get the best results.

The respondents consider in 100% percent that not applying quality control in the manufacturing process of organization product creates a competitive disadvantage in the market.

The results of question number eight indicate that the organization is aware that not applying quality control in the manufacturing process can create a competitive disadvantage.

This study reflects the situation of the company and is aware of possible errors in the production process and how to eliminate or reduce unproductive events.

Two important events were discovered in the study that influences the quality of the organization's management, these were the maintenance of low production and non-compliant products. For a better analysis, the cause-effect diagram was made in order to know clearly and objectively the defects discovered in the production process, taking into account the non-productive elements.

The cause-effect diagram is a way of organizing and representing the different theories proposed about the causes of a problem. It is also known as the Ishikawa diagram or fish bone diagram and is used in the diagnostic and solution phases of the cause.

The best way to identify the causes of the problem to be analyzed is through a brainstorming session in which all members of the process present their ideas and opinions about the origin of the problem root and then group it into categories and complete with them the Cause-Effect diagram or the Ishikawa diagram.

In this way, the cause-and-effect analysis was carried out to determine the root cause of the problem presented in SC Ridorail's production process. An action plan to improve competitiveness is through productivity.

In reality, productivity must be defined as an efficiency indicator that correlates the amount of resources used with the amount of production obtained.

The classical fishbone diagram take in consideration the effects (problem) and establish the possible causes like equipment, process, people, materials, environment and management of production process (Figure 7).

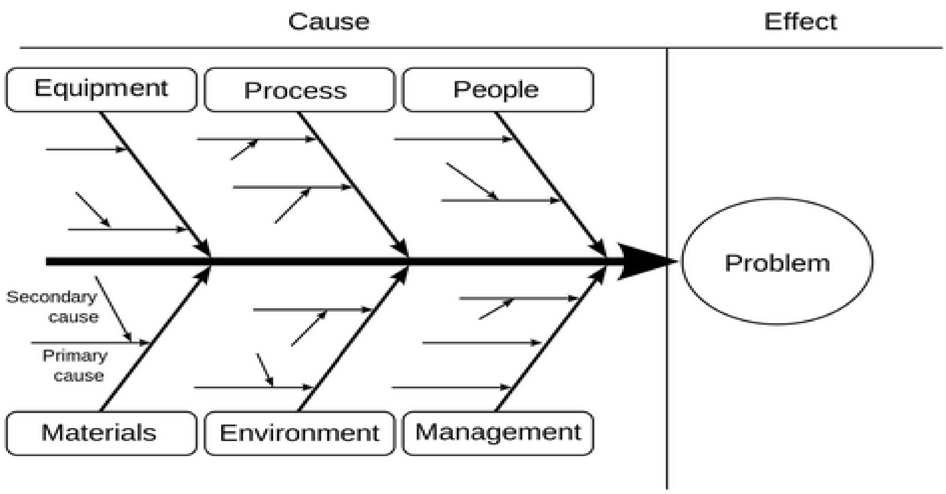

Figure 7. Example of a generic Ishikawa fishbone diagram
Source: https://commons.wikimedia.org/w/index.php?curid=6444290 (by Fabian Lange)

Adapting the classic diagram to the conditions of the company subject to the case study, the diagram was adapted to the effects of problems identified in the production process.

The company does not currently have an action plan that will allow it to measure, to improve the company's management in order to optimize its production.

The design of an action plan to improve productivity allows for improved decision-making capacity regarding the company's management control.

This will reduce the occurrence of production losses, reduce operating costs, and select an appropriate raw material, which will influence better operational stability, increase productivity and competitiveness.

According to Angie (2019) and Ishikawa (1991), the following steps were taken to analyze the root cause in the present case:

a) Identify the problem this is the head of the fish;
b) Brainstorming for potential causes and fish bones;
c) As brainstorming takes place, respondents are asked "what each potential cause seems to be
d) When the brainstorming is over, priority is given to the causes according to the probability that they are the cause of the problem and how easy they are to solve, which have the greatest effect on the problem.

a. The fish bone diagram for low production

The technique used was brainstorming. A group of seven people was formed: the head of production, the heads of workshops, the purchasing manager, the stock manager, the order manager, the administrator and two workers. The elaborated chart identified the main causes of the studied problem.

These are the causes or aspects specific to each category that was present in the analysis because it has a direct or indirect relationship.

The study of low productivity was presented as a problem, having as possible causes its generation of raw materials, equipment, working methods, work environment and human resources (Figure 8).

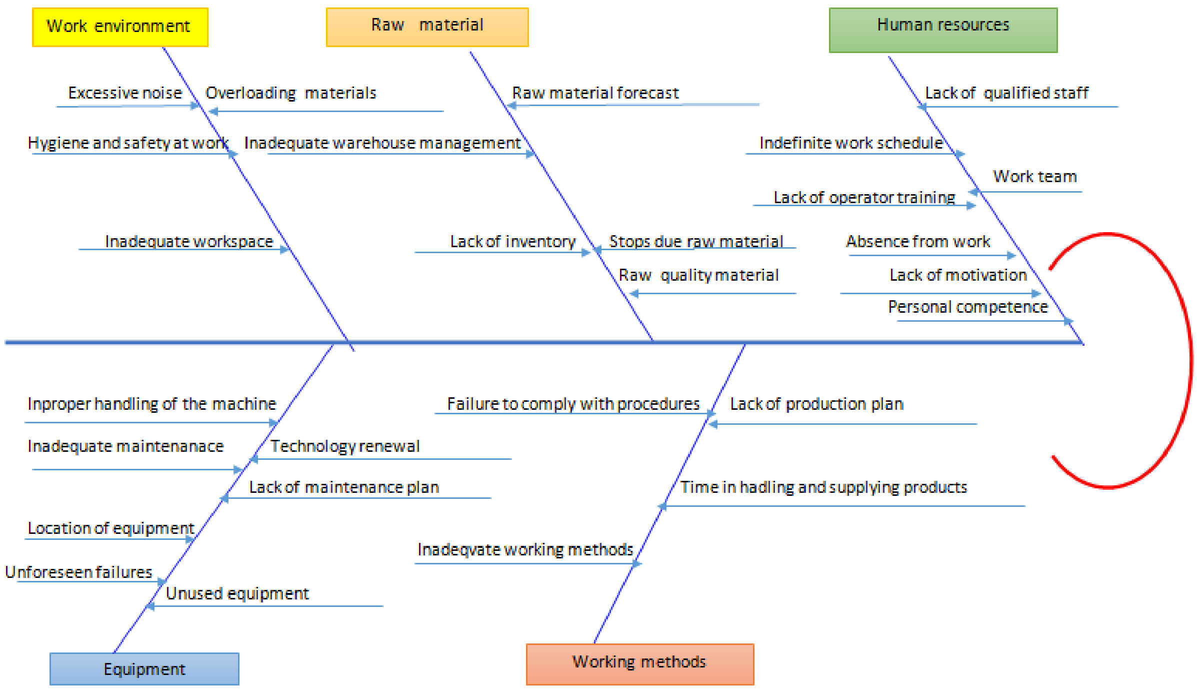

Figure 8. Fishbone diagram for low productivity

The basic idea is to stop the production process when a defect occurs and to prevent the defect from occurring again. Errors must be detected before they become defective and corrected so that they do not recur. Costs are always lower if defects are found and resolved in a timely manner. It is imperative that the inspection be performed at each stage of the technological process. The following defects are observed in the production process: the diameter of the holes made differs; the thread is improper, deformations by grinding, cracked parts, cutting the rods to smaller dimensions and parts of different sizes when cutting sheet metal.

Also, special attention must be paid in the operation (Baur and Wee, 2015) of packaging the products because operators do not receive clear instructions on how to pack, the use of coupons. Verification is required in the packaging process because products are packaged that are not paired or missing components.

Gluing the appropriate barcode is a task that must be done primarily by the performer. It is important to train staff and better organize how to work.

The tables are loaded, and the pieces do not have fixed, marked places to be easily found by the performers. Achieving a high level of quality depends on the quality of services provided by providers.

Product quality starts with raw material quality.

A particular importance is the qualitative verification of the received materials. Uneven painting, leaking paint and sticking packaging paint are other common quality problems.

These are primarily due to the technology used, the raw materials and the methods used.

The elaborated chart identified the main causes of the studied problem.

These are the causes or aspects specific to each category that was present in the analysis because it has a direct or indirect relationship.

There is no fixed indicator on the efficiency and inefficiency of operators and machines in the area, ie a study showing the use of working hours, so it is very important to get an indicator to know what steps need to be taken to change the working methodology in the area.

There is a great lack of motivation due to low work incentives.

One of the main problems that lower the productivity index is the indefinite work schedule.

Overtime is often ineffective due to fatigue.

Lack of work is one of the main problems facing company.

Staff turnover has a negative impact on productivity.

Employees take on additional tasks and take time to train new employees. There are also shortcomings in staff planning.

There are times when some machines have been without an operator and situations in which the worker has no work or does not know what to work and is waiting.

Staff needs to be guided in the day-to-day activities they need to perform and the techniques they should use to achieve ideal performance.

In addition, it is necessary to receive training on all the machines present in the area and the processes that take place in it.

There are constant faults in certain machines, mechanical or electrical, which often require the presence of corrective maintenance.

Some cars have outdated technologies.

There are defects that cannot be repaired and stop production, due to improper maintenance, regular operation is not guaranteed. There is a deficiency in the distribution and allocation of materials, ie there is no fair distribution of materials in each car.

In addition, there are often delays in deliveries or transfers of raw materials to workbenches, respectively from one section to another.

Improper warehouse management leads to expectations in the production process.

Arranging products according to demand will allow their efficient collection.

The area where the production process takes place has minimal ventilation, in addition to the excess noise caused by the machines present in it, thus causing discomfort and fatigue to the operators working there.

These real causes of the inconveniences, identified by the cause-effect diagrams (Ishikawa), should be as points for improvement, it will be established which improvement proposal will be implemented based on the information collected (the real causes of the company's problems).

b. Fish bone diagram for non quality products

After establishing and identifying the problems, each will be solved using the 5 M’s method and Ishikawa diagram to find the main problem in each process. Then, in the improvement stage, finding the solution for each problem will be done by brainstorming (Noor, 2021).

Starting from the answers of the respondents from the identified negative effect, respectively low quality products, by applying the cause-effect diagram, we tried to identify the causes that led to this effect.

For example, in the diagram below, (Figure 9) the shape of a fish’s skeleton is formed by possible causes, grouped by category, for a failed inspection.

From the cause-effect diagrams above, it can be concluded that the main causes are as a result:

a) Inadequate planning of tasks to be performed (Planning and operational control);

b) Lack of working procedures (selection of suppliers, internal and external communication procedure, etc.);
c) Inadequate staff recruitment methodologies (competence required of workers, lack of commitment, etc.);
d) Lack of control;
e) Lack of maintenance.

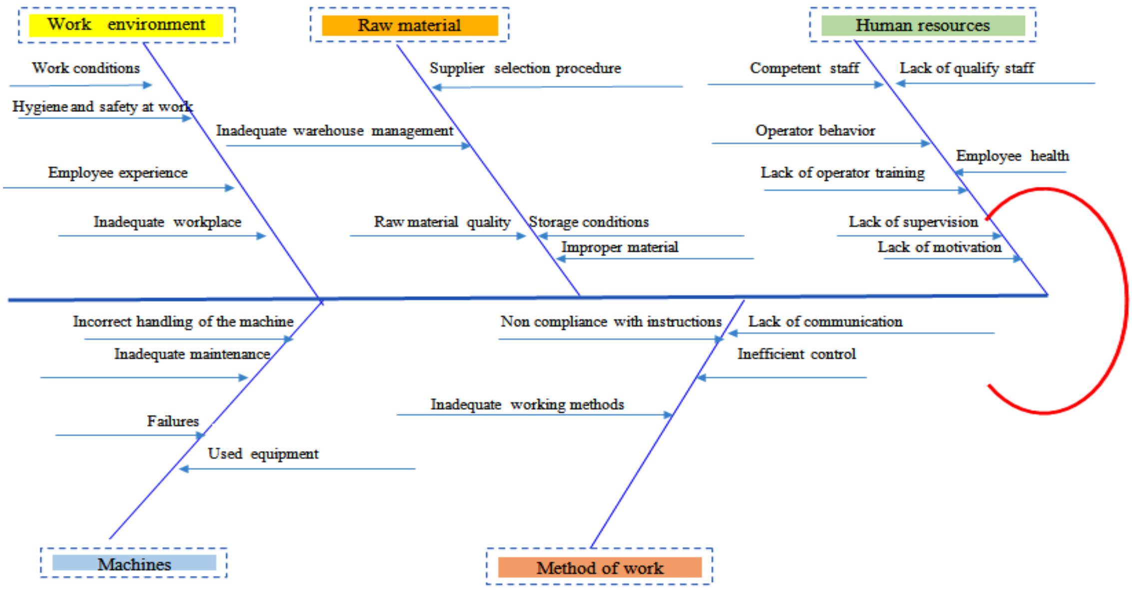

Figure 9. Fish bone diagram for non quality products

Starting from the 5M's respectively, machine, man/mind power (workers), measurement methods, materials raw and micro-environment/medium we obtained the fishbone diagram using these as prompts to generate hypotheses for the root cause of a problem.

Taking into account the internal and external factors that led to low quality products we can mention for each of the five elements possible internal or external causes of influence:

M1-microenvironment– work conditions, inadequate workplace;

M2-materials-storage conditions, materials quality, improper materials;

M3-men-human resource-lack of quality staff, of motivation, competency;

M4-machines-failures, lack of maintenance, incorrect handling;

M5-method of measure, lack of communication, inefficient control.

The causes that lead to complaints and the return of products by customers are the following:

a) inappropriate color;
b) different barcode; different heel;
c) product not in accordance with the specifications;
d) open packaging;
e) lack of products in the set packaging and no part components.
f) one of the main causes is the non-compliant color of the products.

Defects were found during the production process, among which can be listed: scratched sheet, pipes of another diameter, rusty pipes.

Chromium plating and nickel plating of products is not at the desired level.

Timely delivery of products by suppliers is another important aspect in the quality of services offered.

The transport of materials in non-compliant conditions was observed. This led to the rusting of the purchased materials.

The home delivery service of orders placed online was also claimed.

A first step is to define the desired quality parameters and choose the suppliers. The quality and efficiency of the raw material processing processes are what guarantee a final product of good quality and reasonable costs.

When designing a product, there are many processes that can be improved or even eliminated. These must be carefully analyzed to obtain an optimal end result.

It is imperative that the inspection be carried out at each stage of the technological process. The following defects are observed in the production process:

a) the diameter of the holes made differs;
b) the thread is improper,
c) deformations by grinding,
d) cracked parts, cutting the rods to smaller dimensions and parts of different sizes when cutting sheet metal.

Uneven painting, leaking paint and sticking packaging paint are other common quality problems.

These are primarily due to the technology used, the raw materials and the methods used.

There is a deficiency in the distribution and allocation of materials, ie there is no fair distribution of materials in each car.

In addition, there are often delays in deliveries or transfers of raw materials to work tables, respectively from one section to another. Improper warehouse management leads to expectations in the production process.

Arranging products according to demand will allow their efficient collection.

The area where the production process takes place has minimal ventilation, in addition to the excess noise caused by the machines present in it, thus causing discomfort and fatigue to the operators working there

6 CONCLUSIONS

The study conducted at SC Ridorail, shows the importance of quality control as an administrative tool for improving manufacturing processes.

Achieving a high level of quality depends on the quality of services provided by suppliers, the technology used, the raw material and the methods applied.

For the most likely causes, depending on their impact on the efficiency and effectiveness of the production process, it is recommended to establish strategic plans to improve productivity and raise the quality of products according to the Table 1 below:

Table 1. Solution to improve quality management

The most likely causes	Solutions	Objective
Organizing the Production process	✓ Standardization of working times and methods; ✓ Learning new technical procedures; ✓ Drawing flow charts; ✓ Material handling and transport; ✓ Quality policy setting; ✓ Strict quality control throughout the production process.	✓ Reducing the number of operations; ✓ Reducing the execution time of operations; ✓ Reducing unnecessary material handling; ✓ Decrease in the number of defective products and the number of complaints; ✓ Evaluation of operator efficiency

Equipment failures	✓ Development of a preventive maintenance plan; ✓ Annual maintenance programs ; ✓ Establishing the costs of the maintenance plan.	✓ Reducing the quantity of defective products and reducing costs with returned parts; ✓ Reducing accidental downtime due to malfunctions; ✓ Reducing equipment repair costs
Personal	✓ Facilitating the constant training of workers; ✓ Improving staff recruitment; ✓ Salary system; ✓ Improving working conditions; ✓ Plan to improve safety at work; ✓ Staff satisfaction assessment.	✓ Increasing operator efficiency through motivation; ✓ Decrease in the number of defective products and the number of complaints.
Raw material	✓ Defining the quantity of raw material supplied; ✓ Qualitative and quantitative reception of raw materials; ✓ Supplier evaluation.	✓ Reducing raw material costs. ✓ The quality of the raw material; ✓ Raw material in stock; ✓ Ensuring quality raw materials in the production process.

After collecting, interpreting and analyzing the information obtained in the study, it was established that:

a) manufacturing processes can be improved by applying quality control, bringing benefits to the organization;
b) it has been established that quality control is not applied in all processes, it is partially applied because they do not have all the information necessary for a good quality control;
c) there is no specialized person for planning, organizing, coordinating and quality control.

The elaboration of the cause-effect diagram highlighted the causes that lead to a low productivity, thus being classified as the most important:

1. Lack of production planning;
2. Non-compliance with work procedures and methods;
3. Organization of internal transport;
4. Unforeseen failures;
5. Motivation of staff;
6. Location of equipment;
7. Failure to ensure the raw material on time. An improvement plan has been devised based on the causes of unproductive events.

The objectives that the proposal for improvement should have are:

1. Elimination of delays in product delivery;
2. Reduction and elimination of complaints for quality defects and / or customer requirements are not met;
3. Improving administrative and operational management, through the correct design and control of its processes.

As quality improvement at SC Ridorail is essential, manager and staff have made the following decisions:

- ➢ Staff must be regularly informed in connection with the new modern management techniques, on quality control, which can be used as an administrative tool, which helps to improve the quality of the product, thus leading to the increase of their competitiveness on the market;
- ➢ Implementation of training programs, in order to make known new quality control techniques and thus the

application of the necessary standards required by the design of production processes;

- The need to supervise manufacturing processes thus ensuring and guaranteeing quality, the use of strict quality control for the selection of raw materials and its various components;
- The manufacturing process to be improved through quality control which leads to cost reduction, product deterioration and above all its quality;
- Hiring a person responsible for implementing a quality management system in the organizational structure of the company a "Quality Manager" who has the necessary skills to apply methods and techniques for quality improvement, to coordinate quality control in various processes related to product manufacturing to meet quality standards and especially customer needs.

As a final conclusion taking into account the two negative effects identified and after establishing the causes that led to these effects, we can say that the company must delegate a special person to the quality department to closely monitor the quality throughout the production process.

BIBLIOGRAPHY

Alex Gray, (2016). The 10 skills you need to thrive in the Fourth Industrial Revolution | World Economic Forum. *The World Economic Forum*.

Angie Lin Boyer (2019), Fishbone (Ishikawa) Diagram, Available on https://tulip.co/blog/fishbone-ishikawa-diagram-template-for-root-cause-analysis/

Analysis of the cause of the defect packaging of capsule https://www.semanticscholar.org/paper/Analysis-of-the-cause-of-the-defect-packaging-of-A-Fidiyanti-Susanto/5674cd968bf92d720b465cb69a27a3e2fc02e

Baur, C.; Wee, D. (2015). Manufacturing's Next Act. Retrieved at: www.mckinsey.com/business-functions/operations/our-insights/manufacturings-next-act

Berman, A.F., Nikolaichuk, O.A., Yurin, A.Y., Kuznetsov, K.A., (2015), Support of Decision-Making Based on a Production Approach in the Performance of an Industrial Safety Review, *Chemical and Petroleum Engineering*, vol. 50, no. 11–12, pp. 730-738,

Byers JF, White SV. *Patient safety: principles and practice: springer publishing company.* 2004. [Google Scholar]

Coccia, Mario, (2020), Fishbone Diagram for Technological Analysis and Foresight (October 26, 2020). *Int. J. Foresight and Innovation Policy,* Vol. 14, Nos. 2/3/4, pp. 225-247

Cheng, Schon Z. Y. Liang, Rosa María Arnaldo Valdés, Víctor Fernando Gómez Comendador; Francisco Javier Sáez Nieto (2019), A Case Study of Fishbone Sequential Diagram Application and ADREP Taxonomy Codification in Conventional ATM Incident Investigation, *Symmetry* 11 (2019): 491.

Dyah Utari; Syahrul Meizar Nasri (2021), Work environment affects patient safety climate in a government hospital, *International Journal of Public Health Science* (IJPHS) Vol. 10, No. 1, March 2021, pp. 61~67

Ecobici, M.L. (2017) The analysis of causes and effects of a phenomenon by means of the fishbone diagram, *Annals of the „Constantin Brâncuşi" University of Târgu Jiu*, Economy Series, Issue 5/2017

Fabiś-Domagała, J., (2017), Application of Ishikawa diagram for failure analysis of a car water pump, *Technical transactions* 8/2017 Mechanics DOI: 0.4467/2353737XCT.17.141.6892 Available online at: https://www.ejournals.eu/pliki/art/9796/

Finsaria Fidiyanti; Novie Susanto, (2018), Analysis of the cause of the defect packaging of capsule products using six sigma: A case study (PT SM), *ICES 2018, SHS Web of Conferences* 49, 02011 https://doi.org/10.1051/shsconf/20184902011

Gerald Gartlehner; Marie-Therese Schultes; Viktoria Titscher; Laura C. Morgan; Georgiy V. Bobashev; Peyton Williams; Suzanne L. West, (2017), User testing of an adaptation of fishbone diagrams to depict results of systematic reviews, *BMC Med Research Methodology* 17, 169, Published online 2017 Dec 12. doi: 10.1186/s12874-017-0452-z

Ishikawa, K., (1991), Guide to Quality Control, Asian Productivity Organization

James, A.T.; Gandhi, O.P.; Deshmukh, S.G. (2017), Assessment of failures in automobiles due to maintenance errors. Int. J. Syst. Assur. Eng. Manag. 2017, 8, 719–739. [CrossRef]

Luo, T.; Wu, C.; Duan, L. (2018), Fishbone diagram and risk matrix analysis method and its application in safety assessment of natural gas spherical tank. *J. Clean. Prod.* 2018, 174, 296–304. [CrossRef]

Noor, M Rafli Ichwan (2021) *Analisa Defect Untuk Meningkatkan Kinerja Produksi Cable Protector Dengan Menggunakan Metode 5 Whys Dan Fishbone Diagram (Studi Kasus: PT XYZ).* Undergraduate thesis, Institut Teknologi Sepuluh Nopember

Ravi Shankar Raman, Yadavalli Basavaraj,(2019), Quality Improvement of Capacitors through Fishbone and Pareto Techniques, *International Journal of Recent Technology and Engineering* (IJRTE), Volume-8 Issue-2, July 2019

Szymon T. Dziuba: Małgorzata A. Jarossová, Natalia Gołębiecka (2021), Applying the Ishikawa diagram in the process of improving the production of drive half-shafts, *International Journal of Public Health Science (IJPHS)* Vol. 10, No. 1, March 2021, pp. 61~67 DOI: 10.11591/ijphs.v10i1.20629

Tomescu, C. (2008). *Managementul calitatii*, Editura SITECH, Craiova

Wahab, N.A.; Rusli, R.; Shariff, A.M.; Buang, (2014), A. Assessment of Human Factor Performance Using Bayesian Inference and Inherent Safety. *Mater. Ind. Manuf. Eng. Res. Adv*. 2014, 845, 658–662. [CrossRef].

Work environment affects patient safety climate in a government. Available on line at: https://scholar.ui.ac.id/en/publications/work-environment-affects-patient-safety-climate-in-a-government-h

Yurin, A.Y., Berman, A. F., Dorodnykh, N. O.; Nikolaychuk, O.A., Pavlov, N.Y., (2018), Fishbone diagrams for the development of knowledge bases, *41st International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO),*pp. 0967-0972

https://bmcmedresmethodol.biomedcentral.com/articles/10.1186/s12874-017-0452-z/figures/1

https://commons.wikimedia.org/w/index.php?curid=6444290 (by Fabian Lange)

https://ieeexplore.ieee.org/document/8400177//

https://library.lincoln.ac.uk/items/eds/bth/126898484?resultsUri=items%3Fquery%3Dsubject%253A%2528Fishbone%2Bdiagrams%2529%26facet%255B0%255D%3DEdsRecordOptions%253A%2522IsPeerReviewed%2522%26target%3Deds