

Application Of Process Control Statistics On Aircraft Rib Products

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Abstract

A company cannot be separated from consumers and the products it produces. Consumers certainly hope that the goods they buy will be able to meet their needs and desires so that consumers expect that these products have good and guaranteed conditions. This study aims to analyze product quality control using control charts in statistical process control methods for Rib products. The analytical method used is to make a control chart c which is used to analyze products that have defects or non-conformities that can still be repaired and samples that are constant. Equipped with check sheets, Pareto diagrams, and cause and effect diagrams. From the analysis using a causal diagram, it can be seen that the main factor causing disability is the human factor so that companies can take preventive and corrective actions to reduce product mismatches and improve product quality.

Keywords

Quality control, defective products, control chart.

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Introduction

Companies must see and maintain that the quality of the products produced is guaranteed and accepted by consumers and can compete in the market. Quality control in companies, both service companies and manufacturing companies, is very necessary, because the quality of services and goods produced can attract consumers and can meet consumer needs and desires. Quality control that is carried out properly will have an impact on the quality of the products produced by the company. The quality of the products produced by a company is determined based on certain sizes and characteristics. Although the production process has been carried out properly, in reality there are still errors where the quality of the product produced is not in accordance with the standards or in other words the resulting product is damaged or defective in the product. Product quality is the ability of a product to carry out its functions, including durability, reliability, accuracy, ease of operation and repair as well as other valuable attributes. For this reason, quality control is needed to keep the products produced in accordance with applicable quality standards. The quality standards in question are raw materials, production processes, and finished products. Therefore, quality control activities can be carried out starting from raw materials, during the production process to the final product and adjusted to the established standards. The level of product conformity that can be accepted by a company can be determined by measuring the level of product damage that can be accepted by the company by determining the tolerance limit of the resulting product defects, using the quality control method using statistical tools, namely the deep quality control method. In practice using statistical tools contained in statistical process control (SPC) where the production process describes its quality from the beginning of production, when the production process takes place until the finished product. Before being thrown into the market, products that have been produced are inspected first, where good products are separated from defective products so that the number of products produced is reduced. The background of the emergence of statistical processing control is due to the difference in quality between products of the same type, the same process sequence, produced on the same machine, the same operator and environmental conditions, and this problem always arises in manufacturing companies that produce in large quantities.

Quality control with statistical tools is also useful for monitoring the level of efficiency so that it can be used as a tool for detection that minimizes damage and prevention that avoids or prevents defects from occurring. Detection is usually carried out on finished products and prevention is carried out as early as possible so that defects in the product can be prevented.

Literature Review

Quality

The definition of quality is the ability of a product, be it goods or services, to fulfill the desires of its customers so that every product or service is always referred to to fulfill customer desires (Gaikwad, 2020). Quality is the totality of features and characteristics of a product or service that is capable of satisfying a visible or disguised need (Heizer, Render, Munson, & Sachan, 2017). Quality is whatever the consumer needs and wants. Quality is the overall features and characteristics of a product or service that is able to satisfy visible or disguised needs (Suhardi & Marindra, 2020). Quality is the totality of characteristics and characteristics of a product or service that is capable of meeting the needs and desires of consumers, both explicit and hidden. Quality control is a real step activity of operations management in its efforts to carry out management functions in operating activities. The function is control, operations management focuses on controlling the quality of goods and services that will be produced in accordance with established standards and meet consumer needs. Very tight competition makes entrepreneurs increasingly aware of the importance of product quality in order to compete and get a larger market share. Companies need a way that can realize the creation of good quality in the products it produces and maintain its consistency so that it remains in accordance with market demands, namely by implementing a quality control system for the process activities undertaken.

Quality Control

Quality control is an activity carried out to ensure that production and operating activities are carried out in accordance with what is planned and if there is a deviation, the deviation can be corrected so that what is expected can be achieved. The definition of quality control is an activity that is oriented towards preventing damage, and not focusing on efforts to detect damage only. Quality control can be defined as activities carried out to monitor activities and ensure actual performance. The objectives of quality control are:

1. So that the goods produced can reach the quality standards that have been set.
 2. Strive for inspection costs to be as small as possible.
 3. Strive for the design costs of products and processes using certain production qualities to be as small as possible.
 4. Strive for production costs to be as low as possible.
- Factors that can affect the company's quality control are:

Process capability

The limits to be achieved must be adjusted to the capabilities of the existing process. There is no point in controlling a process within limits that exceed the capabilities or capabilities of the existing process.

Applicable specifications

The specifications of the production results to be achieved must be applicable, when viewed in terms of process capability and the wishes of the consumer needs to be achieved from the production results. In this case, it must be ascertained whether the specifications can be applied from the two aspects specified above before the quality control in the process can be started.

Acceptable level of nonconformity

The purpose of controlling a process is to reduce the product that is below the minimum possible standard. The level of control applied depends on the number of products that are below acceptable standards.

Quality cost

Quality costs greatly affect the level of quality control in producing products where quality costs have a positive relationship with the creation of quality products. Quality costs consist of:

Prevention Costs

Costs incurred to prevent damage to the resulting product. These costs include costs associated with designing and maintaining a quality system.

Detection or Appraisal Cost

Costs incurred to determine whether the product or service produced is in accordance with quality requirements so as to avoid errors and damage throughout the production process.

Internal Failure Costs

Costs incurred due to non-compliance with requirements and detected before the goods or services are sent to outside parties (customers or consumers).

External Failure Cost

Costs incurred because the product or service does not meet the requirements that are known after the product is delivered to customers or consumers.

Statistical Quality Control

Statistical process control is a statistical technique that is widely used to ensure that ongoing processes meet standards. Statistical Quality Control (SQC) is a system developed to maintain a uniform standard of production quality, at a minimum cost level and is an aid to achieve efficiency. The steps in statistical process control can be described as:

1. Planning the use of statistical tools (statistical tools).
2. Start using these statistical tools.
3. Maintaining or stabilizing the process by eliminating special preventive variations that are considered detrimental.
4. Plan for continuous process improvement by reducing variation in general.
5. Evaluate and review the use of statistical tools.

SPC can be used by management and production workers because SPC uses statistical methods that make it easier for experts from related companies to solve problems. Management can use SPC as an effective tool to reduce operational costs and improve quality by using its methods for organizing and implementing quality efforts. Process mechanisms become clear so that managers can achieve better strategies for quantity targets. SPC created a new philosophy of management, open communication among employees for the good of the company and new products.

SPC is also useful for employee productivity. Employees can use SPC to develop effective tools to work more efficiently. When employees study SPC, they can tell if their work is good or not. SPC gives them the opportunity to influence the production process and take responsibility for their work. SPC can increase employee pride by allowing them to enter the production process, production workers are usually qualified employees to determine good or bad in each production process. The benefits of SPC (Statistical Process Control) are:

1. Minimize the variations that arise in the process to improve competitiveness.
2. Reduce costs (through control activities at every stage of the process).
3. Increase productivity (reduce errors or defects).
4. Improve employee skills in controlling the process.

Research Methods

The research method is a stage of the steps in a research that must be planned in advance before we conduct a research on the main problems faced by the company. Research methods are needed in a research process in order to facilitate the research steps in answering research questions. The method used by the author in this study is a descriptive method. Descriptive method is a method that describes what the research is doing factually and systematically or in accordance with what has happened to the company by collecting data that is closely related to the problems studied and then an analysis will be carried out. The purpose of this descriptive method is to describe the relevant aspects as a phenomenon of concern from various perspectives.

Data processing is carried out using the tools contained in the Statistical Processing Control (SPC). The steps taken are as follows:

1. Collect production data and damaged products (Check Sheet)

The data obtained from the company, especially production data and damaged product data, is then processed into a neat and structured table. This is done to make it easier to understand the data so that further analysis can be carried out.

2. Determine the priority of improvement by making a Pareto diagram

From the information data regarding the type of product nonconformity that occurs, then a Pareto diagram is made to identify, sort and work to eliminate the nonconformity permanently. With this diagram, it can be seen which type of defect is the most dominant or largest.

3. Create control chart c (c-chart)

In terms of analyzing the data, the c control chart (c-chart) is used as a tool for statistical process control. The use of control chart c is because the quality control carried out is attribute, and the data obtained which is used as a sample of permanent observations and products that experience discrepancies can still be repaired but must be returned to the assembly process section.

The steps in making a control chart c are as follows:

$$\text{Formula : } \bar{c} = \frac{\sum c}{n}$$

$$UCL = \bar{c} + 3\sqrt{\bar{c}}$$

$$LCL = \bar{c} - 3\sqrt{\bar{c}}$$

Where :

\bar{c} = average number of defects rib

$\sum c$ = number of defects rib

n = number of products observed

UCL = Upper Control Limit

LCL = Lower Control Limit

Results and Discussion

The types of non-conformities or defects faced by the company include:

RI : Cracked

Crack is a type of defect on the aircraft, the location and size of the crack can be calculated and it can reduce the safety factor (SF) so that it can reduce the weight of the aircraft because it is very important for the world of aviation.

R2: Countersink

Countersink is a drill knife whose function is to make the base of the hole conical like a funnel. In general, the countersink holes are used for conical bolt heads. The process of making countersinks that do not fit properly between the rivet and the rivet head can affect the manufacture of ribs because ribs are bone inserts that are inside the wing of the aircraft.

R3: Scratched

Scratch is a type of defect that is on the wing of the aircraft or the fuselage, the occurrence of these defects is in the process but can be repaired because in the process of making the rib there are several processes, the most defects occur when the aircraft is used because the aircraft has long been full of scratches, wings very dirty and a lot of paint defects.

In carrying out the production process, the company strives to always produce products that comply with predetermined specifications. However, in an effort to achieve and maintain product quality, sometimes companies are faced with technical problems in the production process. Likewise with the products produced by the company, in fact there are always differences with the specifications set by quality standards even though the differences are very small. Therefore, in carrying out the production process the company must have a standard or deviation limit that is still accepted. With these limits, the company can eliminate and correct deviations that always occur. To overcome this, there are several factors that need to be considered by the company so that the products produced are consistent. The factors that are very important to be considered by the company include:

Labor

The human factor as labor has a complex nature. Physical and psychological factors of each individual will affect the capacity and work performance.

- a. Physical factors are the physical conditions of the workers concerned, such as age and health.
- b. Psychological factors are the mental state of the workforce concerned, such as motivation, work enthusiasm and the daily life conditions of workers.

In addition, the production of Rib is very dependent on the workers because the production process is manual, so humans play a very important role in the company. The entire workforce must be equipped with skills, motivation, attitude of responsibility, and experience to produce quality products or in accordance with established standards.

Raw Material

The raw materials used must be really clean, of good quality, and according to standards. Because raw materials affect the quality of the product to be produced and the smooth production process. The best raw materials at the right price are selected by the company to produce products that meet standards. Therefore, raw materials must be thoroughly researched and inspected at the time they are sent by the supplier. The company must also make sure that raw materials are always available so that there are no production delays.

Machinery and Equipment

Even in manual production, the assembly of the rib component requires an adhesive and testing tool that must be completely clean to avoid test errors. Maintenance is very important for companies because the condition of equipment that is maintained properly will interfere or even hinder the production process. The treatment is to clean the air ducts every day.

Working method used

The working method used by the company is also very influential on the smooth production process. The work method applied in the company functions to regulate all parts involved in the production process so that it will reduce the number of defective products that occur. And vice versa, if the applied method is not executed properly, the possibility of a defective product is greater.

Environmental conditions and working conditions

A good work environment will affect the quality of work of employees and their performance. Good environmental conditions include important aspects such as lighting, noise, temperature, ventilation, odors, and vibrations.

From the Pareto diagram, it can be concluded that the causes of product discrepancies per unit are R2 (100%), R1 (0%), and R3 (0%). Meanwhile, after being accumulated, the biggest type of discrepancy or defect is countersink.

1. Boring

In the manufacture of rib, the company uses several drill bits in drilling work, namely:

- a. Twist Drill is a drill knife that serves to make new holes with a cylindrical shape.
- b. Core Drill is a drill knife that serves to re-drill rough holes.
- c. Counterbore is a drill knife that functions to make a large diameter hole at the base of a hole.
- d. Countersink is a drill knife that serves to make the base of the hole conical like a funnel. In general, the countersink holes are used for conical bolt heads. More defects in the countersink sometimes do not fit the rivet.
- e. The Spot Facer is used to smooth the surface around the circular hole.
- f. Reamer is a slicer that functions to slightly enlarge the hasl twist drill hole to get the hole wall to be smooth.

g. Boring tools is a slicing process to enlarge the diameter of the hole. Boring tools are iris tools used in the boring process.

The result of the calculation of the control limit c , the Central Line value from the examiner is 0.65. While the Lower Center Line and Upper Center Line are 0 and 3,069, respectively.

Conclusion and Suggestion

Conclusion

Based on the results of the analysis of research that has been done, it can be concluded that:

1. The company has not been optimal in implementing quality control of the rib production process because the quality of the production process is beyond the control limits that should be. This indicates that the process is in an uncontrolled state or is still experiencing deviations.
2. The type of discrepancy that occurs in the rib production process is based on the Pareto diagram that has been made, the highest level of discrepancy is countersink with a percentage of 100%. The rest types of defects crack and scraich with a percentage of 0% due to no defects in the study period. The factor causing the countersink mismatch is where the rivet head does not fit into the rivet, it can affect the rib construction because the rib is the direction of the rib which is inside the wing of the aircraft.
3. Factors causing discrepancies in the rib production process based on the results of the analysis using a cause-and-effect diagram, which come from factors of workers, raw materials, equipment, and the work environment.
- 4.

Suggestion

Some suggestions that can be submitted to the company are as follows:

1. The company should re-check the maintenance schedule of the machines used in the product production process to prevent damage.
2. The company should improve the operator's ability by increasing employee training time.
3. Companies should conduct regular briefings before working hours start and after break hours are over regarding important information as a reminder to operators to avoid mistakes during the production process.

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