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QUALITY COST ANALYSIS FOR THE IMPROVEMENT OF DENIM FABRIC QUALITY

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Abstrak: Persaingan di sektor ekonomi melibatkan persaingan harga dan kualitas dalam bisnis. Keunggulan kompetitif dapat diperoleh jika perusahaan mampu menghasilkan produk berkualitas dengan harga yang kompetitif. Penelitian ini bertujuan untuk mengevaluasi implementasi pengendalian kualitas oleh PT X guna mencapai keunggulan dalam persaingan industri ekonomi melalui biaya kualitas. Penelitian ini menggunakan metode deskriptif dengan pendekatan kuantitatif. Hasil penelitian menunjukkan bahwa biaya penilaian memiliki proporsi terbesar, yaitu 87,58%, diikuti oleh biaya pencegahan dengan persentase 11,93%, dan biaya kegagalan internal dengan persentase terendah, yaitu 0,49%. Total biaya kualitas yang dihasilkan memenuhi standar maksimum baik menurut aturan umum sebesar 2,4% maupun standar perusahaan sebesar 1% per divisi, yaitu 0,593%. Temuan ini mengindikasikan bahwa PT X telah berhasil menjalankan pengendalian kualitas dengan baik. Namun, perusahaan perlu meningkatkan investasi pada biaya pencegahan, terutama dalam pelatihan dan pendidikan karyawan serta kalibrasi mesin, untuk menghasilkan kain berkualitas dan mengurangi tingkat produk cacat menjadi 0. Tindakan ini akan meningkatkan efisiensi produksi perusahaan.

Kata kunci: Biaya Kualitas; Pengendalian Kualitas; Kain Denim; Cacat Kain Denim

Abstract: *Business competition in the economic industry encompasses both price and quality competition. Competitive advantage can be achieved when a company produces quality products at an appropriate price. This study aims to determine the extent to which PT X has implemented quality control to win the competition in the economic industry through the application of quality costs. The research method used in this study is descriptive research with a quantitative approach. Based on the research results, appraisal costs have the largest proportion, accounting for 87.58%, prevention costs are in second place with a percentage of 11.93%, and internal failure costs are the lowest with a percentage of 0.49%. The total quality costs generated meet the maximum standards, both according to the rule of thumb of 2.4% and the maximum company standard of 1% per division, which is 0.593%. This indicates that the quality control of PT X is well established, but the company needs to increase prevention costs, especially for training and education expenses, as well as machine calibration costs, in order to produce quality fabric and reduce defective products to a level of 0. This way, the company can achieve production efficiency.*

Keywords: *Quality Costs; Quality Control; Denim Fabric; Defective Denim Fabric*

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I. INTRODUCTION

In today's business environment, competition among companies involves both price and quality competition. Some companies emphasize their marketing strategy on affordable prices, while others emphasize the strategy on producing high-quality products. To achieve competitive advantage, companies must establish appropriate prices and maintain good quality for their products and services. Product quality is one of the key marketing strategies that significantly influence the performance of a product or service [1]. Product quality has a close relationship with customer satisfaction and loyalty. This is evidenced by a previous study in the Journal of Management and Business Start-ups, which analyzed the influence of product quality, promotion, price, location, service quality, and trust on customer loyalty. Through an oral survey conducted with 28 respondents, the following data was obtained: Product quality 32.14%; Promotion 25%; Price 17.85%; Location 10.71%; Service quality 7.14%; and trust 7.14% [2]. Based on the survey results, it can be observed that product quality is the factor with the highest percentage among respondents in relation to customer loyalty. This indicates that economic competition in the industrial world is becoming increasingly fierce because product quality is one of the most important aspects when a company aims to dominate and expand its market share.

PT X is one of the textile companies located in Bandung Regency. One of its products is denim fabric with various patterns according to customer needs and demands. As one of the apparel companies in Bandung Regency, PT X faces various competitions with other apparel companies, especially considering that according to www.bandungkab.co.id [3], in the Large-Scale Industry Database in Bandung Regency, there are at least 52 apparel companies ready to seize any opportunity to advance their businesses compared to other companies. To overcome this challenge, price and quality have become weapons for companies to capture market share because higher product quality leads to higher production costs and selling prices.

Quality is a relative measure of the level of goodness or suitability of a product in determining business competition, alongside factors such as innovation, promotion, and other important factors to meet customer satisfaction and be the key to company success [4]. A product or service is considered to be of high quality if it meets the following eight dimensions of quality: 1) Performance, the main function of a product; 2) Aesthetics, the attractiveness of the product; 3) Serviceability, ease of maintenance and repair over a long period of time; 4) Features, additional characteristics of a product; 5) Reliability, the product's ability to function without failure or damage; 6) Durability, the product's lifespan in terms of economic and technical aspects; 7) Quality of conformance, the degree to which the product meets established standards; 8) Fitness for use, the product's suitability for user needs [5]. Therefore, as a business entity with the goal of survival and maximizing profit, a company must maintain and even improve the quality of its products. Currently, there are various methods available to identify and evaluate the quality of a company's products, one of which is the implementation of quality costs. Narsa (2019) defines quality costs as expenses incurred by a company due to products not meeting established quality standards. These costs are associated with prevention, identification, correction, and improvement of products resulting from low quality [7].

Quality costs can be broadly classified into two categories: costs of control aimed at achieving a certain level of quality (cost of obtaining) and costs incurred due to poor product quality (cost from lack of quality). Control costs are further classified into two categories: prevention costs and appraisal costs. Prevention costs are expenses incurred to prevent defects or damage to products or services during the production process. Increasing these costs is expected to reduce or even eliminate failure costs to a level of zero defects. On the other hand, appraisal costs are expenses incurred to ensure that the produced products meet the acceptance criteria. In addition to control costs, costs incurred due to poor product quality are also classified into two categories: internal failure costs and external failure costs. Internal failure costs are expenses incurred due to failures in the internal processes before the products are delivered to customers. External failure costs, on the other hand, are expenses incurred due to defective products that have already been delivered to customers. Examples include warranty costs, repair claims, returns, claim adjustment costs, and so on [6].

In producing a product, management must pay attention to the production process and understand quality costs in planning, controlling, and making decisions regarding product quality [8]. Quality control must be implemented from the selection of raw materials, the production process, to the finished product. Items or products that do not meet the company's specifications but are still passed on to the next stage will result in

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additional costs because the finished goods do not meet the established quality standards and cannot be sold at the appropriate price [9].

This research is conducted to understand the quality control process at PT X in order to improve product quality. So far, the company has made various efforts in quality control, including incurring quality costs to produce products that meet the established quality standards. However, the challenges currently faced by the company in implementing this program are the lack of human resources with qualifications suitable for the company and the inability to predict the level of improvement required when defective products are produced. Therefore, this research is important to serve as a reference for companies facing challenges related to human resources in implementing quality cost programs. Additionally, this research aims to determine the amount of quality costs incurred by PT X and the extent to which quality costs can improve the efficiency of labor, time, and production costs for the company.

II. RESEARCH METHOD

The method used in this research is descriptive research with a quantitative approach to analyze the magnitude of quality costs at PT X using measurement procedures and describe the situation or events based on data according to the research objectives until reaching a conclusion [10]. The subject of this research is the Head of Department at PT X, while the object of the research is the Quality Costs of PT X. The research subject and object are important components in scientific research. The research subject refers to the nature or value of the person who possesses certain variables to be studied and concluded. Meanwhile, the research object is the scientific target to obtain data for specific purposes and usefulness [11].

The data sources used in this research are primary data sources derived from data collection by the researcher through interviews and observations. In addition to primary data, secondary data sources obtained from quality cost reports, books as theory sources, and previous research are also used to support the primary data [12]. The data collection techniques used in this research consist of primary data collection techniques, including interviews and observations, as well as secondary data collection techniques conducted through literature review. Interviews involve conversations conducted by the researcher with informants from PT X, specifically the Head of the Denim division, who is considered to have important information about a specific object [13]. Observations in this research are carried out through direct observation at the PT X location to observe and systematically record relevant information [11]. The data collection technique through literature review is conducted by extracting summaries from previous studies and analyzing overviews provided by experts in written texts. Literature review serves as a foundation for various types of research, creating new ideas, understanding of knowledge, and guiding future research [14]

The data analysis technique used in accordance with the research objectives is descriptive analysis technique to describe or analyze research findings, but it is not used to draw broader conclusions [12]. Once the required data is collected, the researcher will start analyzing the quality cost reports incurred by specific departments. The data analysis technique involves calculating the percentage of each element or type within the quality costs against the total quality costs and total sales of the company. This data analysis is performed using the following formula:

$$\frac{\text{Quality cost component}}{\text{Total quality costs}} \; x \; 100\% \text{ and } \frac{\text{Quality cost component}}{\text{Total sales}} \; x \; 100\%$$

This data analysis becomes an essential component in research to determine whether the quality cost program at PT X has been implemented effectively or not. The findings from analyzing the financial reports can also be used to identify areas for improvement in the company's efforts to implement the quality cost program.

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III. RESULTS AND DISCUSSION

3.1. Results

PT X is a manufacturing company operating in the textile industry. The company produces denim and polyester fabrics. The production of these two fabrics is carried out in separate divisions. This research focuses on the denim division, specifically analyzing the quality costs as the object of study. The denim division was established after the polyester division. The production stages can be outlined as follows:

a. Pre-Weaving: This stage involves separating raw materials from impurities such as lint and plastic waste, and ensuring that the raw materials are free from stains before further processing.
b. Warping: This process entails winding the yarn from cones onto warp beams according to the required construction.
c. Indigo Dyeing: This step involves dyeing the denim fabric with indigo dye, including cooking and dyeing the yarn.
d. Sizing: This process involves applying a starch coating to the yarn to enhance its quality, tensile strength, elasticity, and surface strength.
e. Reaching: This step is performed when there is a change in fabric construction. It involves inserting the warp yarn into the harness and dropper, then passing it through the weaving reed according to the desired construction. This stage is carried out by two operators who serve as yarn feeders and inserters.
f. Weaving: This process involves interlacing the yarns to form a woven fabric.

During the production process, not all fabrics produced have good quality. Based on the survey results, there are defective fabrics produced, ranging from low intensity defects to potentially damaged fabrics.

According to the Head of the Denim Division, several factors can affect product quality, including human resources, materials, equipment (machinery), methods, and costs. One cost that determines product quality is quality cost. Therefore, this research will discuss the analysis of quality costs at PT X, specifically in the denim division, to determine whether improvements are needed in the distribution of each component of the quality costs or not.

Based on the research results, the following is the quality cost report of PT X for the year 2022:

Table I. Quality Cost Report in 2022

Cost Category	Amount
Prevention Cost:	
Training and education cost	IDR 3,000,000
Maintenance cost of machinery	IDR 125,216,531
Total Prevention Cost	IDR 128,216,531
Appraisal Cost:	
Inspection cost	IDR 899,020,795
Cost of specialized staff for field testing	IDR 42,000,000
Total Appraisal Cost	IDR 941,020,795
Internal Failure Cost:	
Cost of rework	IDR 5,225,829
Total Internal Failure Cost	ISR 5,225,829
Total Quality Cost for the Denim Division	IDR 1,074,463,155

After determining the cost of each quality component, the next step is to determine the proportion of each quality cost component to the total quality cost in order to identify which cost has the highest expenditure. This comparison is done to inform the responsible managers in the denim division of PT X, so that they can promptly improve performance related to quality costs, especially those that have the largest impact on the overall quality cost. The researcher will discuss this comparison of quality costs in Table 2.

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Table 2. Comparison of Total Quality Cost with Each Quality Cost Component in 2022

Cost Category	Amount	Percentage (%)
Prevention Cost:		
Training and education cost	IDR 3,000,000	0.28%
Maintenance cost of machinery	IDR 125,216,531	11.65%
Total Prevention Cost	IDR 128,216,531	11.93%
Appraisal Cost:		
Inspection cost	IDR 899,020,795	83.67%
Cost of specialized staff for field testing	IDR 42,000,000	3.91%
Total Appraisal Cost	IDR 941,020,795	87.58%
Internal Failure Cost:		
Cost of rework	IDR 5,225,829	0.49%
Total Internal Failure Cost	ISR 5,225,829	0.49%
Total Quality Cost for the Denim Division	IDR 1,074,463,155	100%

Based on the analysis from the above table, appraisal cost ranks first with a percentage of 87.58%. Prevention cost ranks second with a percentage of 11.93%, and internal failure cost ranks last with a percentage of 0.49%. In the quality cost report for the 2022 period, there were no external failure costs as there were no product returns or customer complaints during that period. The generated quality costs are quite good as they managed to reduce the total internal failure cost to 0.49%.

Based on the rule of thumb, quality costs should not exceed 2.5% per year calculated from total annual sales [15]. Therefore, it is necessary to compare the quality costs with total sales to determine whether the company has spent quality costs within the established maximum limit. If the total quality costs are lower than 2.5% compared to total sales, then the quality costs can be considered efficient.

Table 3. Comparison of Quality Costs with Total Sales in 2022

	Total Sales	Prevention Cost	Appraisal Cost	Internal Failure Cost
Amount	IDR 180,575,892,000	IDR 18,216,531	IDR 941,020,795	IDR 5,225,829
Percentage (%)	100%	0.07%	0.52%	0.593%

After analyzing the quality costs against sales, PT X's quality costs can be considered efficient as they achieve a percentage below 2.5%, specifically 0.593%.

3.2. Discussion

Based on the research findings and analysis, it can be observed that the dominant quality cost is the appraisal cost, specifically the cost of denim inspection amounting to Rp 899,020,795, accounting for 83.67% of the total quality costs. This indicates that PT X is contributing significantly to the improvement of denim fabric through inspection techniques. Inspection itself is one of the quality control methods performed by examining the fabric's condition, repairing reparable defects, and preparing the fabric for the finishing process [16].

In terms of prevention cost, the cost of machine maintenance ranks second at Rp 125,216,531, accounting for 11.69% of the quality costs. According to the Head of the Division, the company has made its best efforts in terms of machine maintenance. In the third position, there is the appraisal cost, specifically the cost of special field trial staff salaries amounting to Rp 42,000,000, representing 3.91% of the total quality costs. The special staff members are part of the Quality Control team assigned by the Head of the Weaving Division to perform a specific task, which is conducting trials on new beams for every first 100 yards of fabric produced. The special staff members are deployed to the field to ensure whether the fabric being tested has a high defect intensity, indicated by Grades B & C, which requires further improvement, or it meets the company's quality standards, indicated by Grade A. This trial is conducted to ensure that the subsequently produced fabric has better quality than before.

In the fourth position, there is the internal failure cost, which refers to the costs incurred by the company for reworking. This cost arises when defective fabric is identified before reaching the hands of customers [17]. Based on the survey results, reworking costs can occur due to several possibilities: (1) The produced fabric has a high defect intensity, and attempting to repair it would only cause further damage,

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necessitating reworking; (2) Inspection operators lack attentiveness and oversight, resulting in defects that should have been repaired being overlooked. Once the fabric undergoes the burning and washing processes, it becomes unrepairable; (3) There are stubborn stains (oil) that cannot be removed in large quantities, making it impossible to send them to customers. Overall, the analysis provides insights into the distribution and proportion of each quality cost component, highlighting the significance of appraisal and prevention costs in the denim division of PT X. Efforts to improve inspection techniques and machine maintenance have contributed to the company's ability to produce fabrics with reduced internal failure costs.

Lastly, the prevention cost consists of training and education expenses, amounting to Rp 3,000,000 per year, and accounting for 0.28% of the total cost of quality. Employee training and education are attended by both managers and regular employees. These training and education programs cover both hard skills and soft skills and are led by respective department heads. Hard skills training is typically dominated by field workers who spend a significant amount of time operating machines in the field. On the other hand, soft skills education is usually focused on the company's managerial staff who oversee activities in the field. Each training program must be tailored to the employees' needs, including the selection of topics and the desired objectives, so that the trainers are chosen accordingly [18]. For regular employees, only representatives from each department participate in these training and education sessions.

In addition to comparing the cost of quality to the total quality cost to determine the proportion, it is also essential to compare the cost of quality to the total sales of the 2022 period to assess whether the total expenses are efficient or not. According to the rule of thumb, the cost of quality should not exceed 2.5% of the total sales [15]. PT X has set a maximum standard for quality costs, which is 1% per division of the total sales. Based on the above analysis, the percentage of quality costs compared to the total sales of the denim division is 0.593%. This indicates that the cost of quality incurred is efficient, as the resulting percentage is below the maximum standard for quality costs.

Based on the survey and interviews, although the internal failure costs of the company are already at a low point, defective fabric products are still being produced due to certain weaving machines that require further research by the machine supplier's technicians. As reported by the inspection operators, *"There are machines that have been difficult to repair for a year and a half, resulting in fabric with significant defects"* (Informant A). Inspection becomes the only way to improve fabric quality while the problematic machines are undergoing repairs.

According to the interviews, "*Human resources are one of the factors that affect the improvement and deterioration of product quality. The human resources referred to are employees who operate the weaving and inspection machines"* (Head of the Denim Division). If the fabric produced by the weaving operators has a high defect intensity, it will undoubtedly hinder the work of the inspection operators, both in terms of production not meeting targets due to ineffective inspection time and factors such as fatigue and boredom from inspecting severely defective fabric yards/meters long. Therefore, even if the company maximizes the appraisal cost, specifically the inspection, up to 100%, it does not guarantee the absence of poor-quality products being produced [19].

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IV. CONCLUSION

Based on the research findings and analysis above, the researcher can conclude that the role of quality costs in quality control is efficient as it meets the maximum standards set by PT X. The company maximizes its efforts in the control process, thus reducing the proportion of internal failure costs to the lowest level. However, the management should still pay attention to prevention costs to ensure the production of high-quality fabric and reduce fabric defects to a zero defect level. Quality control efforts implemented through prevention and appraisal costs will lead to increased production efficiency due to a reduction in defective fabric.

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