

Failure Cost Analysis of Plywood Quality Using the COPQ Method

Riana Puspita¹, Muhammad Fazri², Refiza³, and Zufri Hasrudy Siregar⁴

¹Department of Industrial Engineering, Faculty of Engineering, Universitas Medan Area, Indonesia

^{2,3}Department of Industrial Engineering, Faculty of Engineering, Universitas Al-Azhar Medan, Indonesia

⁴Department of Mechanical Engineering, Faculty of Engineering, Universitas Asahan, Indonesia

Email: 1puspita.riana.ie@gmail.com

Abstract— The manufacturing industry focuses on producing high-quality products, addressing defects through control, training, and supplier materials. Cost of Poor Quality (COPQ) refers to expenses for repairing non-conforming products, affecting profits and reducing operating costs. Quality costing systems facilitate improvement efforts and continuous evaluations. This research method is Raw materials from suppliers with inconsistent quality conditions are analyzed for production processes, affecting quality and costs. Corrective actions are taken to reduce costs and ensure appropriate production quality. Failure costs arise when a company produces a product that does not conform or experiences damage during delivery. The leading causes of failure are sizing and cutting processes, with costs ranging from IDR 10,750,000 to IDR 9,500,000. Training workers and quality failures in assembly and finishing processes also contribute to these costs. The cost of grading and crating procedures does not show any failure costs. External failure costs arise from damage to the product or packaging after production, distribution, and consumer reception. The total cost of poor quality is IDR 200,160,666, which is equal to both internal and external failure costs. Conclusion Poor quality costs IDR 200,160,666 for internal failures and none for external costs. These costs include raw material nonconformance, workers' ignorance, spare parts not checking, and veneer inspection. Quality control and regular checks can reduce or eliminate these costs.

Keywords— Cost of Poor Quality, Failure Costs, Costs of Quality.

I. INTRODUCTION

The manufacturing industry aims to produce products that meet quality standards at an economical cost. The products produced by the company must have good quality as the main factor for increasing market share, growth, and competitive position. Products must be able to meet the needs and desires of consumers. To obtain a final product that has good quality, each stage of the process in the manufacture of the product must be done with the correct procedures and standards already established. However, there are still products that do not meet the defined quality characteristics (defects). A defective product results from a production process that does not meet the established quality standards and cannot be sold on the market [1].

Efforts to maintain the quality of products can be made by consistently implementing quality control activities in production activities, training workers, and ensuring quality control of suppliers so that the materials supplied have good quality [2].

Quality improvement activities require quality costs for product improvement and quality control. Quality control costs include prevention and evaluation costs, and quality repair costs comprise internal and external

failure costs. To meet good conformity quality, the product specification must be by design, and there must be no defects that can reduce performance or affect the visualization or appearance of the product received by consumers [3]. In developing businesses in the future, it will be necessary to carry out quality improvement activities continuously [4].

As a result of defective products, rework is required to reduce or eliminate defects or discrepancies so that product quality meets predetermined specification standards. Rework will incur additional costs, namely the cost of quality improvement or the cost of poor quality (COPQ). This can be caused by materials, operating conditions, and workers, which have an impact on increasing costs. One of the concepts used to determine the costs due to inappropriate product quality is the cost of poor quality.

Cost of poor quality, namely costs incurred as a result of activities that cause defective products. By carrying out a cost of poor quality analysis, the magnitude of the cost of internal failure and external failure due to inappropriate products will be known.

II. LITERATURE REVIEW

The cost of Poor Quality (COPQ) is the cost of expenses due to repairing non-conforming (defective) products. The COPQ analysis aims to find out how much cost must be incurred because the product is defective or does not comply with company standards. The calculation of quality costs includes all costs in an effort to repair defective products, which include internal failures, recycling costs, appraisal costs, prevention costs, and external failure costs [5].

Quality costs are material costs and repair process costs needed to repair product defects [6]. Quality costs consist of appraisal costs, prevention costs, external failure costs, and internal failure costs [7]. The quality cost component has a mutually influencing relationship between components [8], and has an effect on achieving profits, and prevention costs have a positive effect on achieving income [9].

Quality costs can increase the efficiency of production costs. Still, they have a minimal role because quality costs are part of the overall costs in the stages of the production process incurred by the company [10]. Quality costs, such as internal failure costs, are the greatest compared to external failure, appraisal, and prevention costs [11].

Evaluation of quality costs can be used to describe the magnitude of company profits and the efficiency level of the production process in a quality cost management system [12]. Product control and repair activities that fail are significantly related to total activities [13]. The quality of the products produced can be influenced by the quality of raw materials and the efficiency of production costs [14].

The goal of any quality costing system is to facilitate quality improvement efforts that will lead to operating cost reduction opportunities. The strategy for using quality costs is quite simple: [15]

1. Focus directly on the cost of failure in an attempt to bring it down to zero,
2. Investment in appropriate activities towards improvement,
3. Reducing appraisal costs according to the results achieved,
4. Carry out continuous evaluations that lead to preventive efforts to obtain further improvements.

III. METHODOLOGY

The research was conducted for one month at PT. Mujur Timber. PT. Mujur Timber is a company that manufactures wood logs into plywood with Marine, BB/CC+, BB/CC, and Combi qualities. The primary raw material standard for making plywood is logs with the characteristics of a maximum diameter of 80 cm and a minimum of 60 cm, a length of 8 m, and a wood age of 4-6 years. Raw materials are obtained from suppliers with non-uniform quality conditions.

The research is carried out systematically and structured through four stages.

In the first stage, field observations were conducted to determine which research objects were feasible based on existing conditions and available literature.

The second stage is conducting a literature study based on open books and journals to look for theoretical concepts that will be used as the basis for research by the observations made.

The third stage is collecting data directly at the research location to observe and collect data on the production process at each step of the process, especially those that have an impact on production quality and those that are of inappropriate quality, so they have an effect on costs that are detrimental to the company.

This includes those caused by materials, workers, machines, working conditions, etc. In addition to direct observation, interviews were conducted with workers or companies related to the research object.

The fourth stage is data processing to find out the amount of production that is not appropriate, processes or jobs that have an impact on spending costs that shouldn't, and efforts to improve to avoid the same incident resulting in expenses.

Calculation of quality costs needs to be done for all stages of the production process when making products. It is necessary to identify factors that cause quality costs and corrective actions to reduce quality costs [16].

Ultimately, all costs are added up and form a COPQ, namely additional expenses incurred to obtain the appropriate production quality from receiving raw materials until consumers receive the product.

IV. RESULT AND DISCUSSION

A. Internal Failure Cost Analysis

Failure costs arise within the company while producing a product that does not conform and after the product is in the hands of the consumer when a complaint or

damage occurs during product delivery. To overcome this, each stage of the process is studied and analyzed so that the failure costs that arise are known. The steps of the process to be analyzed can be seen in Figure 1.

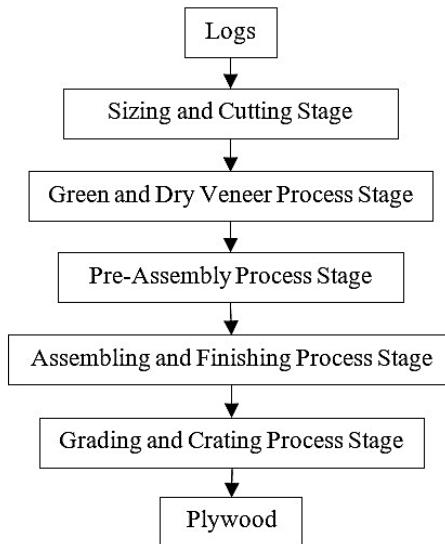


Figure 1: Stages of the production process

1. The cost of failure in the sizing and cutting process

Failure costs in the sizing and cutting processes are caused by the fact that the raw materials received are not all according to existing standards and by workforce training.

• Unsuitable Raw Materials

Raw materials come from suppliers who have collaborated with the company and, besides that, also from the community. The raw materials received are of various sizes, and not all are according to the desired

size based on predetermined standards. For this reason, it is necessary to select raw materials to comply with the specifications (diameter, length, and age). Inappropriate raw materials impact production quality, so the costs incurred include the cost of quality failure. This is to the results of research by [17], which found that quality costs affect production costs, which consist of prevention costs (product process design costs) and internal failure costs (excess remaining raw materials). The costs incurred due to non-compliance with natural materials can be seen in Table 1 below.

Table 1: Incompatible raw material costs

Material Sources	Incompatible raw materials (logs)	Price (IDR.)	Total (IDR.)
Supplier	15	250.000	3.750.000
Public	35	200.000	7.000.000
Total cost (IDR)			10.750.000

Thus, the cost of failure due to inappropriate raw materials in the sizing and cutting process is IDR. 10,750,000.

• Cost of training the worker

The workers in the sizing and cutting processes are temporary workers who live around the factory. The workforce does not have sufficient knowledge about the

work being performed, so when carrying out the work, it will result in the veneer being torn and unusable due to human error. This results in losses because defective products will reduce production results. As a result, [18] a significant relationship exists between prevention and appraisal costs for damaged products in the final product. To overcome this, workers must be given training and an understanding of the process so that no

veneer is torn and not used. For this, a fee of IDR 1,762,083 is required.

2. Cost of the Green and Dry Veneer Process

• **Cost of training the worker**

The same is the case with problems in the sizing and cutting processes; workers who work on green and dry veneer processes are temporary workers or pieceworkers from the community around the factory. Workers do not have sufficient knowledge about the work being performed, so when carrying out their work, it will result in quality deviations with defects in face veneers, short-core veneers, and long-core veneers. To overcome this, workers must be given training and an understanding of the process so that no surface is torn and unused. For this, a fee of IDR 1,762,083 is required.

• **Spare parts and replacement costs**

A dry veneer machine is used in the green and dry veneer processes. A maintenance fee of IDR is required to maintain the quality of the process. 9,000,000 was required. This fee is for replacing spare parts, namely wire rollers that are damaged due to many stuck veneers. The cost is used for six times the replacement of the 10-meter-long wire roller.

3. Costs in the Pre-Assembly Process

The cost of quality failure in the pre-assembly process is IDR 7,290,000, which adds three workers to the veneer inspection section. Additional work is carried out to overcome delays in automatic sewing and tapping processes caused by the torn veneer in the previous method. In addition, it also reduces the impact of defects on production outcomes.

4. Costs in the Assembling and Finishing Process

The cost of quality failure in the assembly and Finishing processes is IDR. 159,876,500. This cost is required for

rework because the product produced does not meet specifications. The rework process is carried out to cover existing cracks, long holes, edge damage, and wormholes so that the product can still be used with quality according to specifications. This defect occurs due to raw materials or labor. This cost consists of wages for four workers who rework in the amount of IDR. 9,720,000; the cost of buying putty is IDR. 806,500, and the cost of buying sandpaper is IDR. 149,350,000.

5. Cost Analysis in the Grading and Crating Process

In the grading and crating process, the selection is made to classify quality, packing, and labeling. The quality group comprises marine, BB/CC+, BB/CC, and combi. At this stage, no failure costs have been found. Because the production process runs according to the procedure, there is no accumulation or reduction of workers.

B. External Failure Cost Analysis

External failure costs are caused by damage to the product or product packaging after completion of the production process, during distribution, and until consumers receive the product. In other words, the costs incurred as compensation due to damaged or inappropriate effects when received by consumers.

At the time of the research, there were no consumer complaints about the quality of the products received or whether the products received were by the specified specifications. Thus, there is no expenditure on external or external failure costs equal to zero.

C. Cost of Poor Quality Analysis

The cost of poor quality is the sum of internal and external failure costs. Based on the analysis carried out on internal and external costs, the total cost of poor quality is IDR. 200,160,666. Details of these costs can be seen in Table 2 below.

Table 2: Details of quality failure costs

Type of Cost	Source of Costs	Cost Items	Cost (IDR)
Internal Failure Cost	Sizing and cutting processes	Unsuitable raw materials	10.750.000
		Worker training	1.762.083
	The green and dry veneer process	Worker training	1.762.083
		Spare part replacement	9.000.000
	Pre-assembly process	Additional veneer inspection workers	7.290.000
	Assembling and finishing processes	Wages of workers for caulking rework	9.720.000
		Putty for rework	806.500
		Wages of workers for rework smoothing	9.720.000

		Sandpaper for rework	149.350.000
External Failure Cost	Compensation	Distribution	0
Total Cost of Poor Quality (IDR.)			200.160.666

V. CONCLUSION

The total cost of poor quality is IDR—200,160,666 for internal failure costs and none for external failure costs. Internal failure costs are found at each stage of the process. Types of cost elements incurred due to quality failures consist of costs caused by raw materials not conforming to specifications, workers not knowing and understanding the work being done, not checking spare parts, and adding workers for veneer inspection and rework processes. These costs will be reduced or eliminated if quality control is carried out from the beginning of the production process until consumers receive the product. In addition, there is also a need for regular checks so that repairs can be made before fatal damage occurs.

ACKNOWLEDGMENT

Acknowledgements to the Leaders and Employees of the Plywood company, PT. Mujur Timber, who has participated in helping bring this research to completion.

REFERENCES

- [1] S. Midian Immanuel Sihombing, "Pengaruh Pengendalian Kualitas Bahan Baku dan Pengendalian Kualitas Proses Produksi terhadap Kuantitas Produk Cacat dan Dampaknya pada Biaya Kualitas (Cost of Quality)," *Jurnal Ilmu Manajemen & Bisnis*, vol. 8, no. 2, pp. 42-49, 2017.
- [2] E. W. N. P. C. B. Ray H. Garrison, *Managerial Accounting*, New York: McGraw-Hill/Irwin, 2012.
- [3] P. C. B. R. H. G. Eric W. Noreen, *Managerial Accounting for Manager*, Boton: McGraw-Hill Irwin, 2012.
- [4] J. T. S. K. W. Nefriani Ester Sandag, "Analisis Biaya Kualitas Dalam Meningkatkan Profitabilitas Perusahaan Pada CV Ake Abadi Manado," *Jurnal EMBA: Jurnal Riset Ekonomi, Manajemen, Bisnis dan Akuntansi*, vol. 2, no. 2, pp. 1212-1338, 2014.
- [5] F. M. Obied-Allah, "Quality Cost and Its Relationship to Revenue Sharing in Supply Chain," *Accounting and Finance Research*, vol. 5, no. 3, pp. 173-189, 2016.
- [6] P. Darsono Prawironegoro, *Akuntansi Manajemen*, -: Mitra Wacana Media, 2013.
- [7] E. W. N. P. C. B. Ray H. Garrison, *Managerial Accounting*, New York: McGraw-Hill/Irwin, 2012.
- [8] A. N. Evi Yuniarti, "The Effect of Quality Cot on The Rattan Industry Performance," *International Journal of Social Sciences and Development*, vol. 2, no. 1, pp. 39-44, 2018.
- [9] S. S. Domingus B Jotlely, "Analisis Biaya Kualitas (QUALITY COST) Terhadap Pencapaian Laba Pada Rumah Sakit Sumber Hidup Kota Ambon," *Jurnal SOSOQ*, vol. 7, no. 1, pp. 78-99, 2019.
- [10] F. S. B. Tasya Meisheilla Aditya, "Analisis Biaya Kualitas Dalam Meningkatkan Efisiensi Biaya Produksi Pada PT Aceh Media Grafika Tahun 2012-2016," *Jurnal Ilmiah Mahasiswa Ekonomi Akuntansi*, vol. 3, no. 1, pp. 67-81, 2018.
- [11] P. I. Suripatty, "Analisis Keefektifan Biaya Kualitas Di PT Karya Papua Nabire," *JURNAL FATEKSA: Jurnal Teknologi dan Rekayasa*, vol. 2, no. 1, pp. 62-72, 2017.
- [12] J. H. M. K. M. H. a. E. Č. Tomáš Holota, "The Management of Quality Costs Analysis Model," *Serbian Journal of Management*, vol. 11, no. 1, pp. 119-127, 2016.
- [13] M. M. H. Retno Martanti Endah Lestari, "Pengaruh Biaya Kualitas Terhadap Tingkat Penjualan Pada PT Mitra Sejati Mulia Industri," *Jurnal Ilmiah Akuntansi Fakultas Ekonomi*, vol. 6, no. 2, pp. 34-41, 2014.
- [14] I. Muhammad Satar, "Pengaruh Kualitas Bahan Baku dan Efisiensi Biaya Produksi Terhadap Kualitas Produk Pada CV. Granville," *Jurnal Ilmiah Akuntansi*, vol. 10, no. 3, pp. 89-101, 2020.
- [15] D. D. S.N.Telia, "Assessment of Cost of Poor Quality Using Knowledge based System," *International Journal of Engineering Research & Technology (IJERT)*, vol. 2, no. 2, pp. 1-10, 2013.
- [16] S. R. Z. Casban, "Analisis Cost of Poor Quality Proses Painting Produk Pan Oil TD," *Jurnal INTECH Teknik Industri Universitas Serang Raya*, vol. 8, no. 1, pp. 9-16, 2022.
- [17] D. W. H. H. Angelia Angelia, "Peranan Analisis Biaya Kualitas Dalam Meningkatkan Efisiensi Biaya Produksi," *Jurnal Ilmiah Akuntansi Kesatuan*, vol. 7, no. 1, pp. 205-212, 2019.
- [18] R. M. Yuniastuti, "Biaya Kualitas Terhadap Minimalisasi Produk Rusak Pada Produk Home Industri Pembuatan Peyek Kacang," *GEMA: Jurnal Gentiaras Manajemen dan Akuntansi*, vol. 13, no. 1, pp. 13-21, 2021.