



The Effect of Prevention Costs, Appraisal Costs, and Internal Failure Costs on the Operational Productivity of Manufacturing Companies at PT. Rumah Jelantah Surabaya

Imam Rulyadi^{1*}, Yulika Wahyu², Eko Riswanto³, Naufal⁴, Shodik⁵, Ravi Hilal⁶, Maria Yovita R. Pandin⁷, Hwihanus⁸

Fakultas Ekonomi dan Bisnis, Universitas 17 Agustus 1945 Surabaya, Indonesia

Corresponding Author: Imam Rulyadi irulyadi@gmail.com

ARTICLE INFO

Keywords: Prevention Costs, Appraisal Costs, Internal Failure Costs, Operational Productivity

Received : 29, December

Revised : 30, January

Accepted: 26, February

©2026 Rulyadi, Wahyu, Riswanto, Naufal, Shodik, Hilal, Pandin, Hwihanus: This is an open-access article distributed under the terms of the [Creative Commons Atribusi 4.0 Internasional](https://creativecommons.org/licenses/by/4.0/).



ABSTRACT

This study investigates the impact of quality-related expenditures—specifically Prevention, Appraisal, and Internal Failure Costs—on Operational Productivity within a manufacturing context. Employing a quantitative causal design, the research utilized twelve months of secondary data derived from internal financial and production reports. Data analysis was conducted via SPSS, utilizing multiple linear regression, classical assumption tests, and hypothesis testing (t-test and F-test). The findings reveal that Prevention, Appraisal, and Internal Failure Costs each have a statistically significant individual effect on Operational Productivity. Furthermore, when analyzed collectively, these three variables simultaneously exert a significant influence on productivity levels. Based on these results, it is recommended that the company prioritize investment in prevention and appraisal measures to minimize failure-related costs. Future research avenues should consider incorporating External Failure Costs, extending the timeframe to annual data, or exploring different industrial sectors to broaden the study's applicability.

INTRODUCTION

In an increasingly competitive manufacturing industry era, companies are compelled not only to produce high-quality products but also to maintain optimal operational efficiency. Operational productivity serves as a vital indicator reflecting the extent to which a company can transform inputs into outputs according to established quality standards without resource wastage. However, the phenomenon often observed in the field shows that efforts to increase productivity are frequently hindered by product quality issues resulting in rework and raw material wastage (Gaspersz, 2012). To resolve this, it is crucial to rigorously deploy Cost of Quality (CoQ) management as a key strategic tool. Hansen and Mowen (2018) characterize these costs as financial burdens resulting from goods that do not satisfy quality requirements. They further divide these expenses into prevention, appraisal, and both internal and external failure costs.

In the context of this research, the primary focus is directed toward three cost components that have a direct impact on internal processes before the product reaches the consumer. Prevention costs are the initial investments made by the company to prevent defects, such as employee training costs, preventive machine maintenance, and quality planning (Blocher et al., 2019). Furthermore, appraisal costs are costs incurred to detect product defects through raw material inspection, in-process testing, and quality audits (Horngren et al., 2015). Meanwhile, internal failure costs are costs arising from defects discovered before the product is shipped, which include scrap, rework, and machine downtime (Supriyono, 2017). Theoretically, increases in prevention and appraisal costs are expected to suppress internal failure costs to a minimum, ensuring the production process runs smoothly without significant interruptions.

PT. Rumah Jelantah Surabaya, as a manufacturing company engaged in processing used cooking oil waste into value-added products (such as biodiesel raw materials or other derivative products), faces unique operational challenges. Based on initial observations, the problem phenomenon occurring at PT. Rumah Jelantah Surabaya is the existence of productivity fluctuations suspected to be caused by the high variability of incoming raw material quality. It is often found that minimal initial sorting (prevention) and lax inspection (appraisal) cause processing machines to suffer blockages or breakdowns, leading to high internal failure costs. When machines stop operating for repairs or when semi-finished products must be reprocessed because they do not meet viscosity or moisture content standards, the company's operational productivity automatically drops drastically. This indicates that the management of quality costs at the company has not been fully integrated with operational productivity targets.

The urgency of this research lies in the importance of finding the most efficient composition of quality costs to maximize production output in a waste processing industry characterized by unstable raw materials. If the company does not immediately improve the allocation of prevention and appraisal costs, internal failure costs will continue to erode profitability and impede production

flow. Additionally, there is a research gap from previous studies that underlies the need for this research to be conducted again. Research conducted by Prawira and Susilo (2020) stated that prevention costs have a significant positive effect on productivity, but this contradicts the findings of Sari (2019), who noted that increasing prevention costs actually burdens operational costs without a commensurate increase in productivity in the short term. On the other hand, regarding appraisal costs, previous research by Wijaya (2018) found that excessive inspection actually creates bottlenecks that slow down productivity, differing from the general theory that inspection supports quality. The inconsistency of these research results, particularly in the object of recycling-based manufacturing companies, demands further empirical verification.

The reason the researcher chose PT. Rumah Jelantah Surabaya is that this company represents a developing circular manufacturing business model, where quality cost efficiency is key to business sustainability amidst tight profit margins. Furthermore, there is limited research specifically highlighting the causal relationship between Cost of Quality components and operational productivity in the used cooking oil processing industry sector in East Java. By analyzing the company's quality cost reports and production reports, this research is expected to provide concrete managerial recommendations. The researcher aims to prove whether investments in prevention costs and appraisal costs are truly capable of reducing internal failure costs and ultimately increasing operational productivity significantly. A deep understanding of the interaction of these three variables will assist the management of PT. Rumah Jelantah Surabaya in formulating a more effective quality budget. Therefore, research titled "The Influence of Prevention Costs, Appraisal Costs, and Internal Failure Costs on the Operational Productivity of Manufacturing Companies at PT. Rumah Jelantah Surabaya" is highly relevant and important to conduct.

LITERATURE REVIEW

Prevention Costs

Based on the definition by Hansen and Mowen (2018), prevention costs represent expenditures aimed at avoiding quality failures in goods or services. These costs cover proactive measures implemented either prior to the start of operations or during the actual production cycle. The objective is to eliminate quality non-conformance from the very start. Measurement Indicators:
Total Prevention Costs per period = Training Costs + Planning Costs + Maintenance Costs + Supplier Costs.

Appraisal Costs

According to Blocher et al. (2019), appraisal costs encompass the expenses associated with identifying products that fail to meet technical requirements. These financial outlays arise during inspection, testing, or auditing activities aimed at verifying adherence to established quality benchmarks. Measurement Indicators:

Total Appraisal Costs per period = Incoming Inspection Costs + Lab Costs + In-Process Inspection Costs + Depreciation Costs (Testing Equipment).

Internal Failure Costs

According to Horngren et al. (2015), internal failure costs are costs that arise when product defects are detected before the product is shipped to external customers. These costs represent a form of waste due to poor quality. Measurement Indicators:

Total Internal Failure Costs per period = Rework Costs + Scrap Costs + Downtime Costs + Failure Analysis Costs.

Operational Productivity

Gaspersz (2012) defines operational productivity as the ratio between the output (production results) generated and the input (resources) utilized within a specific time period. Productivity reflects the technical efficiency of the production system. Measurement Indicators:

$$P_{\text{output}} = \frac{T. \text{ Output}}{T. \text{ Input}} \times 100\%$$

Research Framework

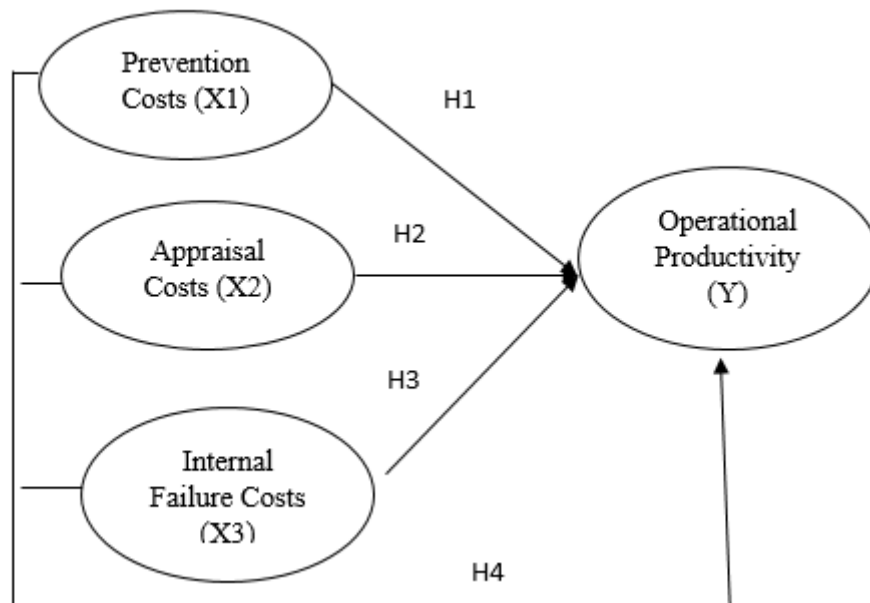


Figure 1. Conceptual Framework Model

Research Hypothesis

This research hypothesis attempts to provide a tentative answer to the problem being studied. Based on the problem proposed and the research objectives, the following hypotheses are presented:

H1 : Prevention Costs partially has a significant effect on Operational Productivity.

- H2 : Appraisal Costs partially has a significant effect on Operational Productivity.
H3 : Appraisal Costs partially has a significant effect on Operational Productivity.
H4 : Prevention Costs, Appraisal Costs, and Internal Failure Costs simultaneously (together) have a significant effect on Operational Productivity.

METHODOLOGY

This research applies a quantitative approach with a causal associative design aimed at examining the cause-and-effect relationship between quality cost components (Prevention, Appraisal, and Internal Failure Costs) and operational productivity at PT. Rumah Jelantah Surabaya. The data used in this study are secondary data obtained through the documentation method of the company's internal reports, specifically covering quality cost reports and production volumes. The sampling technique was conducted using purposive sampling by utilizing monthly time series data from the last one year, resulting in a total of 12 observations that are considered representative and meet the minimum requirements for regression statistical analysis. The data analysis techniques employed in this study include validity tests, reliability tests, classical assumption tests, multiple linear regression analysis, and hypothesis testing using IBM SPSS Statistics Version 27.

RESEARCH RESULT

Validity Test Results

One of the primary determinants of research quality is validity testing, which confirms the relevance of secondary data and the connection between variables. This study assessed validity by contrasting the observed r values with the theoretical r_{table} . Given a sample size of 12 ($df=10$) and an alpha of 0.05, the reference value was set at 0.576. Since the test results for all cost categories and operational productivity consistently surpassed this threshold, the data indicators are confirmed to be valid.

Reliability Test Results

Table 1. Reliability Test Results

Variables	Cronbach's Alpha value calculated	Cronbach's Alpha Value	Information
Prevention Costs (X1)	0.746	0.6	Reliable
Appraisal Costs (X2)	0.832	0.6	Reliable
Internal Failure Costs (X3)	0.812	0.6	Reliable
Operational Productivity (Y)	0.742	0.6	Reliable

Source: Questionnaire data processed using SPSS 27

According to the reliability test results, the Cronbach's Alpha scores were recorded as follows: Prevention Costs (0.746), Appraisal Costs (0.832), Internal

Failure Costs (0.812), and Operational Productivity (0.742). Since every coefficient surpasses the minimum criterion of 0.6, all variables are confirmed to be internally consistent.

Classical Assumption Test

Normality Test

Table 2. Normality Test

One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		12
Normal Parameters ^{a,b}	Mean	.0000000
	Standard Deviation	.31661813
Most Extreme Differences	Absolute	.217
	Positive	.142
	Negative	-.217
Test Statistics		.217
Asymp. Sig. (2-tailed) ^c		.125
Monte Carlo Sig. (2-tailed) ^d Sig.		.122
	99% Confidence Lower Bound	.114
	Interval Upper Bound	.131

- a. Test distribution is Normal.
- b. Calculated from data.
- c. Lilliefors Significance Correction.
- d. Lilliefors' method based on 10000 Monte Carlo samples with starting seed 2000000.

Source: Questionnaire data processed using SPSS 27

Referring to the data presented, the normality assessment for Prevention, Appraisal, and Internal Failure Costs, alongside Operational Productivity, yielded an Asymp. Sig. (2-tailed) of 0.125 for the 12-sample dataset. Since this figure exceeds the standard significance threshold of 0.05 ($0.125 > 0.05$), the residual data is confirmed to follow a normal distribution. Consequently, the study is cleared to advance to the subsequent stages of classical assumption testing.

Multicollinearity Test

Table 3. Multicollinearity Test

Coefficients ^a		
Model	Collinearity Statistics	
	Tolerance	VIF
Prevention Costs (X1)	.004	258,988
Appraisal Costs (X2)	.185	5,395
Internal Failure Costs (X3)	.003	289,713
a. Dependent Variable: Operational Productivity (Y)		

Source: Questionnaire data processed using SPSS 27

According to the table, the model exhibits clear signs of multicollinearity. Specifically, Prevention Costs and Internal Failure Costs show extremely high VIFs (258.988 and 289.713, respectively), well above the maximum limit of 10. This is corroborated by their low Tolerance values of 0.004 and 0.003, which are below the 0.10 standard. Although Appraisal Costs have a lower VIF (5.395) and higher Tolerance (0.185), the overall results confirm that multicollinearity is present in this study.

Autocorrelation Test

Table 4. Autocorrelation Test

Model Summary					
Model	R	R Square	Adjusted R Square	Standard Error of the Estimate	Durbin-Watson
1	.999a	.998	.998	.3713	2,476
a. Predictors: (Constant), Internal Failure Costs, Appraisal Costs, Prevention Costs					
b. Dependent Variable: Operational Productivity					

Source: Questionnaire data processed using SPSS 27

Based on the table above, it shows that the *Durbin-Watson* (DW) value is 2.476 with 3 predictors ($k=3$) and a sample size of 12 ($n=12$). Given the limited sample size, the autocorrelation test uses general criteria stating that if the DW value is between 1.5 to 2.5 (or -2 to +2), then the regression model is considered not to experience serious autocorrelation problems. The calculation results show a DW value of 2.476, which is still within the tolerance range (approaching 2.5). Thus, it can be concluded that there is no significant autocorrelation in this regression model, or in other words, this research is free from autocorrelation problems.

Heteroscedasticity Test

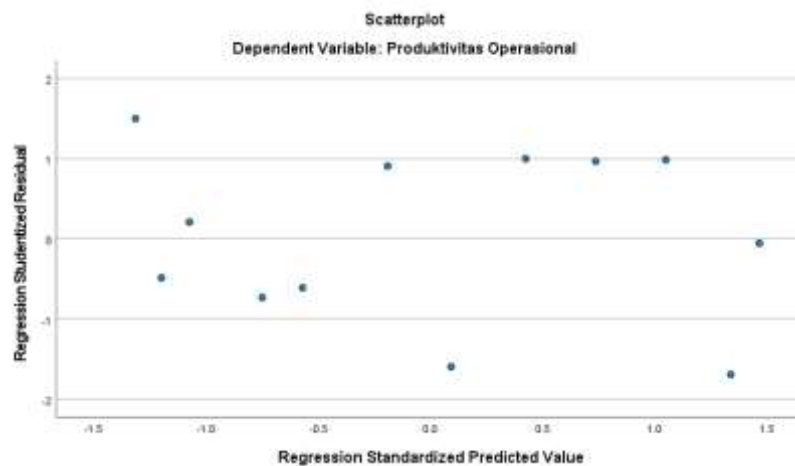


Figure 2. Heteroscedasticity Test

Source: Questionnaire data processed using SPSS 27

The visual inspection of the scatterplot reveals that the data points are dispersed without any discernible pattern, distributed both above and below the zero line on the Y-axis. This random configuration indicates that the residual variance is constant. Consequently, the regression model satisfies the assumption of homoscedasticity (non-heteroscedasticity).

Multiple Linear Regression Analysis

Table 5. Multiple Linear Regression Analysis

Coefficients^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	101,227	7,509		13,481	.000
	Prevention Costs	.020	.141	-.032	4.144	.009
	Appraisal Costs	.044	.059	-.024	3,734	.004
	Internal Failure Costs	.325	.076	-1,019	4,295	.003

a. Dependent Variable: Operational Productivity

Source: Questionnaire data processed using SPSS 27

From the table above, the regression equation model is as follows:

$$Y = \alpha + \beta_1.X_1 + \beta_2.X_2 + \beta_3.X_3 + e$$

$$Y = 101.227 + 0.020(X_1) + 0.044(X_2) + 0.325(X_3) + e$$

Where:

1. Constant Value (α)
The constant value (α) is 101.227. This figure implies that if the independent variables consisting of Prevention Costs (X1), Appraisal Costs (X2), and Internal Failure Costs (X3) are considered constant or equal to 0 (zero), then the value of Operational Productivity (Y) is 101.227. (Theoretically, this is the ideal maximum productivity if there are no quality costs at all).
2. Regression Coefficient of Prevention Costs Variable (X1)
The regression coefficient value of the Prevention Costs (X1) variable is negative at -0.020. This implies that for every one million rupiah increase in Prevention Costs, Operational Productivity (Y) will experience a decrease (correction) of 0.020 units, assuming other variables remain constant.
3. Regression Coefficient of Appraisal Costs Variable (X2)
The regression coefficient value of the Appraisal Costs (X2) variable is negative at -0.044. This implies that for every one million rupiah increase in Appraisal Costs, Operational Productivity (Y) will experience a decrease of 0.044 units, assuming other variables remain constant.
4. Regression Coefficient of Internal Failure Costs Variable (X3)
The regression coefficient value of the Internal Failure Costs (X3) variable is negative at -0.325. This implies that for every one million rupiah

increase in Internal Failure Costs, Operational Productivity (Y) will decrease significantly by 0.325 units. Conversely, if the company succeeds in reducing failure costs, productivity will increase rapidly.

Hypothesis Testing Techniques
Partial Test (t)

Table 6. Partial Test (t)

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	101,227	7,509		13,481	.000
	Prevention Costs	.020	.141	-.032	4.144	.009
	Appraisal Costs	.044	.059	-.024	3,734	.004
	Internal Failure Costs	.325	.076	-1,019	4,295	.003

a. Dependent Variable: Operational Productivity

Source: Questionnaire data processed using SPSS 27

Based on the table above, it can be used as a reference in explaining the results of hypothesis testing in this study, as follows:

1. Evaluation of Prevention Costs (X1). The t-test for this variable resulted in a statistic of 4.144. This figure is higher than the critical table value (4.144 > 1.860), and the associated significance value is 0.009, which falls below the 0.05 alpha level. Therefore, the alternative hypothesis (H1) is accepted, demonstrating that Prevention Costs have a statistically significant effect on Operational Productivity.
2. Evaluation of Appraisal Costs (X2): For this variable, the calculated t value was found to be 3.734. As this exceeds the table benchmark (3.734 > 1.860) and the significance level is 0.004 (< 0.05), the null hypothesis is rejected. Thus, H2 is accepted, confirming that Appraisal Costs significantly impact Operational Productivity.
3. Evaluation of Internal Failure Costs (X3): The test for the third variable yielded a calculated t of 4.295. Since this value is greater than 1.860 and the significance level of 0.003 is less than 0.05, the results support the acceptance of H3. This indicates that Internal Failure Costs exert a significant influence on Operational Productivity.

Simultaneous Test (F)

Table 7. Simultaneous Test (F)

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	708,184	3	236,061	1712,579	.000b
	Residual	1.103	8	.138		
	Total	709,287	11			
a. Dependent Variable: Operational Productivity						
b. Predictors: (Constant), Internal Failure Costs, Appraisal Costs, Prevention Costs						

Source: Questionnaire data processed using SPSS 27

According to the F-test data, the calculated value is 1,712.579, far surpassing the required table benchmark of 4.07. With a significance value of 0.000 (< 0.05), the statistical criteria for rejection of the null hypothesis are met. Therefore, the study accepts H4, demonstrating that when analyzed together, Prevention, Appraisal, and Internal Failure Costs have a simultaneous and significant impact on Operational Productivity.

Determination Test

Table 8. Determination Test

Model Summary				
Modl	R	e	Adjusted R Square	Standard Error of the Estimate
1	.999a	998	.998	.3713
a. Predictors: (Constant), Internal Failure Costs, Appraisal Costs, Prevention Costs				

Source: Questionnaire data processed using SPSS 27

Based on the Adjusted R Square result of 0.998, it is evident that the three cost categories (Prevention, Appraisal, and Internal Failure) have a dominant influence on the dependent variable. Together, they contribute 99.8% to the formation of Operational Productivity levels, leaving only 0.2% to be explained by unmeasured factors.

DISCUSSION

The Effect of Prevention Costs on Operational Productivity

The empirical evidence gathered in this study conclusively supports the first hypothesis, confirming that Prevention Costs exert a substantial influence on Operational Productivity. This finding suggests that financial resources allocated to proactive measures such as comprehensive employee training, rigorous preventive maintenance of machinery, and detailed quality planning are not merely expenses, but critical components of a robust operational structure.

Although accounting records may initially reflect these activities as a financial burden, the analysis reveals that they act as a primary driver for long-term efficiency. By committing to these costs at the earliest stages of the production cycle, the company effectively shifts its focus from 'fixing' to 'preventing.' This proactive approach drastically mitigates the risk of defects, ensuring that resources are not wasted on reworking faulty goods.

This interpretation aligns seamlessly with the Cost of Quality framework established by Hansen and Mowen (2019), which posits that prevention is the most economically sound quality activity. Furthermore, as supported by Putri and Santoso (2022), increasing investment in prevention is the most effective strategy to suppress the exponential costs associated with failure. Without this initial investment, a firm risks being trapped in a cycle of reactive repairs, which ultimately degrades overall productivity.

The Effect of Appraisal Costs on Operational Productivity

The second hypothesis is firmly supported by the results, confirming that Appraisal Costs exercise a significant and positive influence on Operational Productivity. This finding underscores the critical nature of evaluation activities such as rigorous raw material inspections, in-process testing, and comprehensive quality audits within the manufacturing ecosystem.

Functioning as a vital "quality filter," appraisal activities serve to intercept deviations before they escalate. The significant impact of this variable suggests that Quality Control (QC) on the production floor is not merely a compliance requirement but a driver of efficiency. By investing in these detection mechanisms, the company ensures that substandard inputs are identified immediately, preventing them from entering the value chain where they would consume valuable labor and machine hours.

This interpretation aligns with the theoretical framework presented by Blocher et al. (2018) and is corroborated by recent empirical studies from Wijaya and Andini (2021). Both sources argue that expenditures dedicated to detection and appraisal are essential for stabilizing the production process. A strict inspection regime directly boosts the productivity ratio (output to input) by ensuring that resources are only expended on materials that meet the necessary standards, thereby eliminating the waste associated with processing defective items.

The Effect of Internal Failure Costs on Operational Productivity

The empirical evidence strongly validates the third hypothesis, revealing that Internal Failure Costs exert a profound and statistically significant influence on Operational Productivity. In the context of this research model, these costs manifesting primarily as scrap, rework, and unplanned downtime demonstrate a stark inverse relationship with productive output.

This finding identifies Internal Failure Costs as the primary adversary of operational efficiency. The logic is straightforward yet critical: every unit of currency or hour of labor spent correcting a defect is a resource diverted from creating new value. When these costs rise, productivity inevitably declines

because the production system is clogged with 're-doing' work that should have been done correctly the first time. Conversely, the data suggests that suppressing these failure costs is the most direct lever for rapidly elevating productivity metrics.

The implications of this result align seamlessly with the foundational 'Zero Defects' philosophy of Crosby, as well as contemporary findings by Kurniawan (2023). Both perspectives classify Internal Failure Costs as purely 'non-value added' activities. They represent the most detrimental category of quality costs, and their reduction through rigorous process improvement is not just a cost-saving measure, but a fundamental prerequisite for increasing profit margins and operational throughput.

The Simultaneous Effect of Prevention Costs, Appraisal Costs, and Internal Failure Costs on Operational Productivity

The empirical results from the simultaneous test provide compelling support for the acceptance of the fourth hypothesis. The analysis reveals that when Prevention, Appraisal, and Internal Failure Costs are considered together, they explain nearly all fluctuations in Operational Productivity. This overwhelming explanatory power indicates that quality cost management is the dominant factor influencing the company's output efficiency.

The implication is that quality cannot be managed in silos. A strategy that focuses only on catching defects (Appraisal) while ignoring the systems that create them (Prevention) effectively guarantees that Failure costs will remain high. The research proves that these three components work in concert. True productivity gains are realized only when the company orchestrates a balance: investing upfront in prevention to reduce the burden on appraisal and, ultimately, to minimize the waste of internal failures.

This aligns perfectly with established Total Quality Management (TQM) theory. As corroborated by the research of Tjiptono and Diana (2020) and Hidayat (2022), achieving "Operational Excellence" requires a holistic view. Manufacturers must view quality costs not as separate line items, but as a dynamic ecosystem where proactive investment leads to substantial gains in production capability and cost efficiency.

CONCLUSION

Based on the results of the data analysis and discussion regarding the influence of *Prevention Costs, Appraisal Costs, and Internal Failure Costs on Operational Productivity*, the following conclusions can be drawn:

1. Prevention Costs are proven to have a positive and significant influence on the company's operational productivity. This indicates that allocating funds for prevention activities, such as employee training and machine maintenance, is not merely an expenditure burden but a strategic investment. The higher the company's commitment to early prevention, the lower the risk of production errors, which ultimately encourages the creation of efficiency and long-term productivity improvement.

2. Appraisal Costs are proven to have a positive and significant influence on operational productivity. Quality control activities through inspection and testing function effectively as a filter to ensure the standards of raw materials and semi-finished products. The existence of adequate appraisal costs ensures that company resources are not wasted processing defective materials, so the resulting output ratio remains optimal.
3. Internal Failure Costs are proven to have a significant influence on operational productivity. The high magnitude of failure costs, which includes rework and scrap, reflects inefficiency in the production process. This study concludes that reducing internal failure costs is the main key to boosting operational performance, as these costs represent waste that provides no added value to the company.
4. Simultaneously, *Prevention Costs*, *Appraisal Costs*, and *Internal Failure Costs* have a significant effect on operational productivity. This confirms that quality management must be executed as an integrated system (*Total Quality Management*). Synergy between increasing prevention efforts, optimizing appraisal activities, and suppressing failure costs together constitutes the most effective strategy to achieve operational excellence and maximum cost efficiency.

RECOMMENDATION

Based on the conclusions above, the researcher proposes several suggestions expected to be beneficial for the company and other parties:

1. Management is advised not to cut the budget for prevention costs (such as routine training and preventive maintenance). Conversely, this budget should be viewed as primary capital to prevent greater losses in the future.
2. The company must strive hard to suppress Internal Failure Costs to the lowest point. This can be done by conducting periodic evaluations of the main causes of scrap and rework on the production floor.
3. Conduct strict inspections, especially at the raw material intake stage (*incoming quality control*), so that materials entering the production line are truly of high quality, thereby making appraisal costs more efficient.

ADVANCED RESEARCH

1. It is recommended to use a larger sample of companies or compare across different industries to obtain more general results.
2. Further researchers can add external quality cost variables (External Failure Costs) or other moderating variables such as production technology to see their influence on productivity more comprehensively.
3. Given the limitations of this study which uses a certain time period, further research is recommended to extend the observation period (e.g. 3-5 years) to see more accurate long-term trends.

REFERENCES

- Blocher, E. J., Stout, D. E., Juras, P. E., & Smith, S. (2019). *Cost management: A strategic emphasis* (8th ed.). McGraw-Hill Education.
- Garrison, R. H., Noreen, E. W., & Brewer, P. C. (2021). *Managerial accounting* (17th ed.). McGraw-Hill Education.
- Gaspersz, V. (2012). *All in one management tool for total quality management*. Gramedia Pustaka Utama.
- Hansen, D. R., & Mowen, M. M. (2018). *Managerial accounting: The cornerstone of business decision making* (7th ed.). Cengage Learning.
- Heizer, J., Render, B., & Munson, C. (2020). *Operations management: sustainability and supply chain management* (13th ed.). Pearson.
- Hidayat, R. (2022). Analisis pengaruh biaya kualitas terhadap produktivitas produksi pada perusahaan manufaktur di Jawa Barat. *Jurnal Riset Akuntansi dan Keuangan*, 10(2), 145–158.
- Horngren, C. T., Datar, S. M., & Rajan, M. V. (2015). *Cost accounting: A managerial emphasis* (15th ed.). Pearson Education.
- Kurniawan, A. (2023). Dampak internal failure cost terhadap profitabilitas dan efisiensi operasional. *Jurnal Manajemen Industri dan Logistik*, 7(1), 22–35.
- Prawira, A., & Susilo, T. (2020). Pengaruh biaya kualitas terhadap produktivitas pada perusahaan manufaktur sektor barang konsumsi. *Jurnal Akuntansi dan Bisnis*, 12(1), 45–56.
- Putri, L. A., & Santoso, B. (2022). Pengaruh biaya pencegahan dan biaya penilaian terhadap produk cacat dan implikasinya pada kinerja operasional. *Jurnal Akuntansi Bisnis*, 15(1), 88–102.
- Rustiadi, S., & Wibowo, A. (2022). Pengaruh pengendalian biaya kualitas terhadap efisiensi biaya produksi pada industri manufaktur. *Jurnal Ekonomi dan Bisnis*, 9(1), 55–68.
- Sari, D. P. (2019). Analisis hubungan trade-off biaya kualitas dan kinerja operasional perusahaan. *Jurnal Ilmiah Manajemen Produksi*, 7(2), 112–125.
- Slamet, A., & Diyah, S. (2020). Analisis biaya kualitas dalam upaya peningkatan produktivitas kerja pada sektor industri pengolahan. *Jurnal Administrasi Bisnis*, 14(2), 110–124.
- Supriyono, R. A. (2017). *Akuntansi biaya: Pengumpulan biaya dan penentuan harga pokok*. BPFE.
- Tjiptono, F., & Diana, A. (2020). *Total quality management* (Edisi Revisi). Andi Offset.
- Wijaya, H., & Andini, R. (2021). Evaluasi penerapan cost of quality dalam meningkatkan efisiensi biaya produksi. *Jurnal Ilmiah Ekonomi Manajemen*, 12(3), 210–225.
- Wijaya, K. (2018). Dampak appraisal cost terhadap efisiensi waktu produksi pada industri tekstil. *Jurnal Riset Industri*, 9(3), 201–215.