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OPTIMIZING PRODUCTIVITY AND QUALITY MANAGEMENT AT UD SALMA JAYA: STRATEGIES FOR ADDRESSING MACHINE BREAKDOWNS AND OPERATIONAL CHALLENGES

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Abstract

The food and beverage (F&B) industry plays a significant role in Indonesia's economy, contributing substantially to the manufacturing sector's growth. However, small and medium-sized enterprises (SMEs) in this sector often face challenges related to production capacity and product consistency, limiting their ability to meet rising market demand. UD Salma Jaya, an SME specializing in snack production, implemented automation to enhance efficiency but encountered machine failures that disrupted operations. These breakdowns led to decreased productivity and inconsistent product quality, particularly when reverting to manual production. This study aims to identify the root causes of these operational challenges and evaluate strategies for optimizing productivity and product quality. Using Root Cause Analysis (RCA), the Fishbone Diagram, and the Analytic Hierarchy Process (AHP), the study assesses whether investing in new automation technology or improving manual production methods would be the most effective solution. The findings suggest that upgrading machinery while enhancing workforce adaptability through targeted training programs can ensure long-term operational stability. This research provides valuable insights for SMEs facing similar automation-related challenges in the F&B industry.

Keywords: ***Productivity optimization, quality management, machine breakdowns, operational strategy, automation.***

1. INTRODUCTION

A considerable proportion of Indonesia's Gross Domestic Product (GDP) is derived from the food and beverage (F&B) sector, thus constituting a major economic catalyst for the nation. During the initial quarter of 2023, the industry exhibited a year-over-year (YoY) GDP growth of 5.33%, a figure that surpassed the 4.43% growth recorded by the manufacturing sector in its entirety. This is particularly salient given the considerable potential exhibited by micro, small, and medium-sized enterprises (MSMEs). The driving factors behind this potential include the increasing demand for food items, which has been precipitated by population growth and heightened consumer spending. However, MSMEs are not immune to challenges; in some cases, these enterprises encounter difficulties with uneven product quality and limited production capacity. This has the effect of hindering their ability to grow and compete with larger companies.

A significant manufacturing challenge faced by MSMEs pertains to achieving an optimal balance between automation and physical labor. While automation ensures uniformity and efficiency, it concomitantly necessitates substantial maintenance and investment. Demand for UD Salma Jaya, an MSME based in Kediri specializing in dry sponge cakes and snacks, exhibited an average monthly growth rate of 10%. In response to this surge, the business adopted an automation strategy to enhance output and maintain product quality. However, the implementation of automation has been marred by frequent breakdowns in the dough molding machines, necessitating a reversion to manual methods. This has resulted in diminished productivity and variability in the quality of the final product. The inconsistent texture and moisture levels have had a direct impact on business performance, giving rise to dissatisfied customers and a decline in repeat orders.

In view of the aforementioned difficulties, the objective of this research is to examine the impact of labor flexibility and product quality on manufacturing transitions from automated to manual processes. The study seeks to identify the underlying causes of the decline in productivity and propose pragmatic solutions to enhance output

effectiveness. The investigation focuses on determining whether UD Salma Jaya should invest in new automation technology, repair its existing equipment, or improve manual production methods through process and employee enhancement and training. This study emphasizes the operational disruptions brought on by automation failures and explores workable solutions for MSMEs grappling with analogous issues, contrasting earlier studies that predominantly concentrated on the advantages of automation in the F&B industry. The study employs a multifaceted approach, utilizing the Fishbone Diagram, the Analytic Hierarchy Process (AHP), and Root Cause Analysis (RCA), to assess the most effective strategy for preserving output and product quality. The findings of the study offer valuable insights to MSMEs in the F&B sector, providing a foundation for the development of robust operational strategies that strike a balance between automation and manual production, thereby ensuring long-term sustainability.

2. LITERATURE REVIEW

2.1 Operational Management

Operational management (OM) focuses on optimizing organizational resources to enhance productivity and efficiency (Subramanian, 2012). Traditionally, OM strategies emphasized labor-intensive production systems. However, advancements in digital technology and automation have transformed operations in various industries, including food and beverage (Priyatna, 2024). The integration of robotic process automation (RPA) and artificial intelligence (AI) has significantly improved productivity and cost efficiency, reducing human errors and enhancing production consistency (Wibowo, 2023). Despite these advancements, transitioning between automated and manual operations remains a challenge for small and medium-sized enterprises (SMEs). Studies indicate that sudden disruptions in automated systems often lead to operational inefficiencies, requiring robust workforce adaptability strategies (Yuana, 2024). While previous research focuses on automation benefits, there is limited literature exploring the impact of automation failures on manual workforce performance. This study seeks to address this gap by analyzing how SMEs, such as UD Salma Jaya, can mitigate production inconsistencies during automation breakdowns.

2.2 Productivity

Productivity is defined as the ratio of output to input (Kaci, 2006).It is influenced by technology adoption, resource use and labor efficiency (Martono, 2019).Automation affects workforce adaptation by increasing productivity through the simplification of procedures. However, when machines malfunction, employees used to automated systems may experience difficulties in handling manual procedures, which can result in inefficiencies (Girikallo, 2022). Research has highlighted the importance of employee training in enhancing efficiency (AKMAL, 2006). However, there is a paucity of research on how SMEs should create workforce adaptation initiatives to achieve a balance between automation and manual manufacturing. This study investigates focused training initiatives to improve worker flexibility in the event of automation failures, thereby ensuring steady output.

2.3 AHP

Decision-making frameworks, such as the Analytic Hierarchy Process (AHP) and Root Cause Analysis (RCA), are widely used to evaluate operational challenges and develop strategic solutions. AHP is a structured decision-making approach that prioritizes alternatives based on weighted criteria (Darmanto, 2014). It has been applied in various industries to assess investment decisions, particularly in technology adoption and process optimization (Narti, 2019). RCA, on the other hand, is a diagnostic tool used to identify underlying causes of operational inefficiencies (Sammuel, 2024). Previous research highlights AHP's effectiveness in evaluating investment options (Delolme, 2019). However, studies have not extensively applied AHP to automation failures in SMEs. This study employs AHP to compare alternative solutions repairing machines, investing in new automation, or improving manual production methods, while using RCA to identify root causes of productivity decline at UD Salma Jaya.

3. METHOD

This study employs a mixed-method approach, integrating qualitative and quantitative techniques to analyze the impact of automation failures on productivity and product quality at UD Salma Jaya. Primary data is collected through structured questionnaires distributed to 25 production employees, assessing productivity, machine reliability, and workforce adaptability using Likert-scale and open-ended questions. Additionally, semi-structured interviews with the CFO provide strategic insights into operational challenges and automation decisions. Secondary

data from internal reports, sales records, and industry literature offer context and benchmarking. For analysis, descriptive statistics summarize employee perceptions, while Root Cause Analysis (RCA) and the Fishbone Diagram identify key factors affecting productivity, categorized under Man, Machine, Material, Method, Measurement, and Environment (5M+E). To determine the best operational strategy, the Analytic Hierarchy Process (AHP) is used, involving key decision-makers in a pairwise comparison survey to evaluate alternatives repairing machines, investing in automation, or improving manual production. The data is processed with BPMSG's AHP software, ensuring decision consistency through the Consistency Ratio (CR). By combining statistical analysis, RCA, and AHP, this study provides data-driven recommendations to enhance productivity, workforce adaptability, and automation efficiency, offering valuable insights for SMEs facing similar challenges.

4. RESULTS AND DISCUSSION

4.1 Descriptive Analysis of Questionnaire Results

Employee Roles and Experience in Production

The workforce at UD Salma Jaya is distributed across four key production roles: molding, baking, packing, and dough mixing. The molding stage requires the highest labor input (40% of employees) due to its precision, while packing (32%) also demands a substantial workforce. The variation in employee experience levels further affects production stability, with 40% of employees having 1–3 years of experience and 24% having more than six years. While the experienced workforce contributes to efficiency, the presence of newer employees (16% with less than one year of experience) may lead to skill gaps, particularly in manual operations during machine downtime.

Product Quality Consistency: Manual vs. Automated Production

Findings indicate that automated production ensures superior product quality consistency. 80% of respondents rated automated production as "very consistent," whereas manual production received more mixed responses, with many employees citing variations in texture and moisture levels. This discrepancy suggests that manual production is more prone to human error due to differences in technique, experience levels, and process standardization. These findings align with prior research emphasizing the role of automation in reducing variability and maintaining uniformity in food production.

Challenges in Manual Productivity and Workforce Adaptability

The challenges inherent in manual production, which have a significant impact on productivity, have been extensively addressed in the present study. These challenges include delays, skill differences, unproductive workloads, and poor coordination. A substantial proportion of employees, specifically 44%, encountered considerable difficulty in adapting to the transition between automated and manual production. Furthermore, the output of manual production was a substantial 33% lower than that of automatic production, thereby exacerbating the productivity gap. The foreseen challenges have thus been further compounded by the need for training and enhancing the capability and efficiency of the workforce in handling emergencies and coordinating better.

Impact of Machine Breakdowns on Production Efficiency

A significant disruption was identified as a causative factor for production delays and inconsistent quality, with machine failures being a primary contributor. Despite workers' efforts to compensate for lost output through additional hours, the total amount of physical labor produced was inadequate to meet demand. Two primary remedies were proposed to address this issue: (1) the investment in more dependable automation to avoid malfunctions, and (2) the enhancement of manual efficiency during downtime through the optimization of process management. The discussion aligns with industry research on preventive maintenance and technology investments as crucial tactics for reducing downtime, emphasizing the pivotal role that machine reliability plays in maintaining production efficiency.

Availability of Raw Materials and Tools

The responses given by employees when asked to comment on the adequacy of raw materials were, on the whole, of a mediocre nature. Many respondents drew attention to the fact that, although supplies were usually sufficient, sporadic shortages had a greater impact on manual output than on automated manufacturing. This suggests that, in order to guarantee consistency, it is necessary to improve material allocation and resource planning for manual

procedures. Production variability can be decreased by addressing these supply chain issues with improved inventory control and supplier cooperation.

Training and Investment Needs

A significant proportion of workers (92%) expressed support for investment in new automation to enhance productivity and product quality, despite 84% of workers not considering manual training to be a priority. In accordance with industry trends, where automation is increasingly regarded as a long-term solution for operational efficiency, the findings demonstrate a strong preference for technological solutions over manual skill improvement (Groover, 2020). However, given the challenges associated with manual adaptability, a hybrid strategy that integrates automation improvements with targeted training may offer the optimal balance.

Comparison of Manual and Automated Production

Employees overwhelmingly agreed that automation offers superior advantages over manual production in terms of speed, consistency, and capacity. Automation reduces errors and increases efficiency, allowing the company to meet rising demand. However, its dependence on machine reliability underscores the importance of maintenance and contingency planning.

Overall Effectiveness of the Production Process

While the majority of employees rated the production process as effective, moderate ratings suggested areas for improvement, particularly in manual workflow efficiency, workforce adaptability, and machine reliability. Continuous improvements in process optimization, preventive maintenance, and training programs could further enhance overall operational stability.

4.2 Problem Cause Analysis

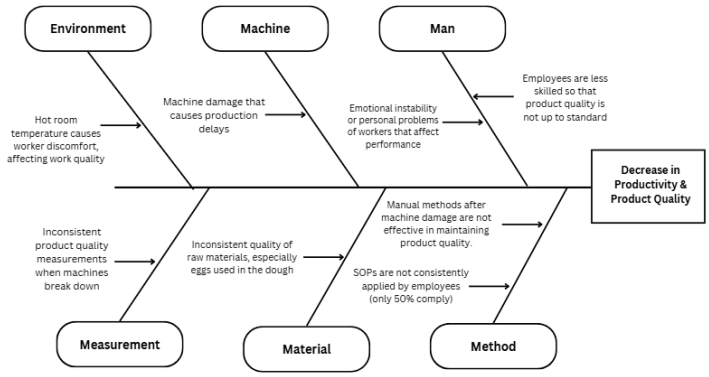

Figure 4.1 Fishbone Diagram

The figure showed the analysis revealed that multiple interdependent factors contribute to the decline in productivity and product quality, particularly during machine breakdowns. Using Root Cause Analysis (RCA) and the Fishbone Diagram (Ishikawa Analysis), the study categorized these issues into six main factors: Man (Workforce), Machine, Method, Material, Measurement, and Environment.

1. Workforce Challenges (Man Factor)

One of the key challenges identified is workforce instability, particularly due to high employee turnover and job dissatisfaction. Younger workers tend to resign frequently, disrupting production continuity. Additionally, financial stress, such as loan obligations, negatively impacts employee focus and productivity, especially toward the end of the fiscal year.

Another critical issue is the difficulty in transitioning from automated to manual production during machine breakdowns. Many employees experience stress when adjusting to manual processes, particularly in high-precision tasks like dough molding. While the company provides daily briefings and coaching, these efforts have not significantly improved adaptability. This aligns with industry research emphasizing the need for structured retraining programs to improve workforce flexibility (Groover, 2020).

To address these workforce challenges, UD Salma Jaya plans to:

- Implement a retention strategy through formal agreements (MoU) to reduce sudden resignations.
- Introduce targeted skill development programs to improve manual proficiency, ensuring smoother transitions during machine failures.
- Strengthen employee support systems to mitigate financial stress, which may include financial literacy training or assistance programs.

2. Machine Reliability and Downtime

Machine breakdowns have been identified as the most critical factor affecting productivity and quality consistency. The dough molding machine, crucial for maintaining output levels, fails approximately once every two months. However, failure rates spike during peak production periods, with breakdowns occurring as frequently as every two weeks in May, September, and November 2024. During these failures, manual production only reaches 80 kg per cycle, significantly lower than the 120 kg per cycle achieved with automation.

Regular maintenance, including daily cleaning and weekly inspections, has not been sufficient to prevent recurring failures. These findings emphasize the importance of predictive maintenance and investment in more reliable machinery, consistent with studies highlighting the role of proactive machine monitoring in manufacturing efficiency (Hakim, 2017).

To address these issues, the company will:

- Upgrade automation technology with more durable and efficient machinery.
- Implement predictive maintenance strategies using failure trend analysis.
- Establish contingency planning to ensure smoother transitions to manual production when breakdowns occur.

3. Inefficiencies in Work Methods (Method Factor)

The study found that manual production methods are not optimized for efficiency, further exacerbating delays during machine breakdowns. One example is the manual butter-spreading process, which is inconsistent and time-consuming. Moreover, only 50% of employees adhere to Standard Operating Procedures (SOPs), leading to inconsistencies in production outcomes.

To improve process efficiency, UD Salma Jaya will:

- Introduce semi-automated tools, such as a butter-spreading machine, to enhance consistency.
- Strengthen supervision by appointing a dedicated quality supervisor responsible for ensuring strict SOP compliance.
- Revise and enforce SOPs through structured training programs and performance-based incentives.

4. Raw Material Challenges (Material Factor)

Raw material availability and quality, particularly eggs and sugar, present ongoing challenges. Egg quality fluctuations affect dough consistency, while sugar price volatility creates procurement difficulties. Current sourcing practices rely on multiple suppliers, but inconsistent stock levels have impacted production planning.

To mitigate raw material risks, the company will:

- Establish long-term supplier contracts to ensure stable pricing and quality.
- Develop a backup supplier network to reduce dependency on primary suppliers.
- Implement a buffer stock system to maintain critical raw materials during supply chain disruptions.

5. Work Environment and Its Impact on Productivity (Environment Factor)

A poor working environment has been cited as a major factor affecting employee performance and well-being. The factory's high temperatures contribute to worker fatigue, particularly during peak production periods. While the company has installed basic air circulation systems, these measures have not significantly improved comfort levels.

To enhance working conditions, UD Salma Jaya will:

- Install industrial cooling systems in key production areas.
- Adjust work shifts during peak seasons to reduce prolonged exposure to heat.
- Increase automation to minimize reliance on labor-intensive tasks during high-demand periods.

6. Inconsistencies in Quality Control (Measurement Factor)

Quality measurement inconsistencies were observed, particularly when manual interventions were required during machine failures. Minor deviations in the mixing process resulted in variations in dough texture, leading to customer complaints and product returns. Although some quality control measures exist, manual processes lack the precision needed to meet higher product standards.

To ensure quality consistency, the company plans to:

- Invest in new machines with integrated quality control systems to reduce manual errors.
- Standardize manual processes through stricter quality control checkpoints.
- Enhance employee training on quality management to reduce defects in manual production.

4.3 Alternatives for Operational Improvement

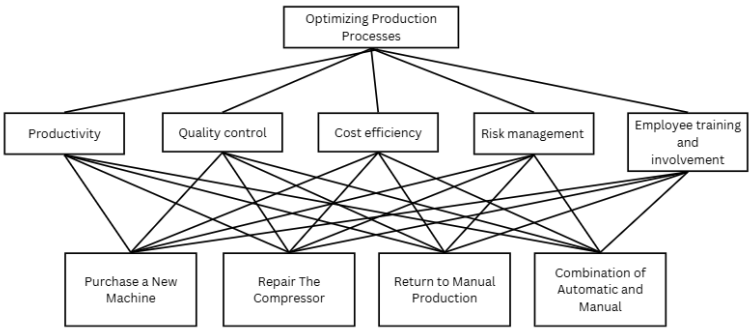

Figure 4.2 Hierarchical Diagram of AHP Analysis.

Based on Figure 4.2, the results of this study focus on identifying and evaluating the most effective alternative for optimizing the production process at UD Salma Jaya. The Analytic Hierarchy Process (AHP) method was employed to systematically assess various alternatives against predefined criteria: productivity, quality control, cost efficiency, risk management, and employee training and involvement. This analysis was conducted with input from key stakeholders, namely the main commissioner, CEO, and CFO as the company's primary decision-makers, with BPMSG software used to automatically process data through pairwise comparisons and determine the priority weight of each criterion.

The most preferred alternative is purchasing a new machine, which has the highest priority weighting of 55.7%, signifying its effectiveness in enhancing productivity, maintaining quality, and reducing operational risks. This is followed by repairing the compressor (29.6%), a cost-effective short-term solution, while returning to manual production (9.7%) and combining manual and automation methods (4.9%) are the least favorable options due to inefficiencies in output and quality control.

Decision Hierarchy						
Level 0	Level 1	Glb Prio.	Purchasing New Machine	Compressor Repairs	Return to Manual Production	Combination of Manual and Automation Methods
Optimizing Production Processes	Productivity 0.402	40.2%	0.571	0.296	0.090	0.043
	Quality control 0.349	34.9%	0.555	0.290	0.100	0.055
	Cost efficiency 0.142	14.2%	0.540	0.302	0.107	0.050
	Risk management 0.071	7.1%	0.525	0.317	0.106	0.052
	Employee training and involvement 0.036	3.6%	0.561	0.296	0.092	0.051
		1.0	**55.7%**	**29.6%**	**9.7%**	**4.9%**

Figure 4.2 Results of the calculation of the alternative weights.

These results suggest that while an initial capital investment is required for a new machine, its long-term benefits far outweigh the costs, making it the most viable solution for UD Salma Jaya.

5. CONCLUSION

This study concludes that the transition from automated to manual production at UD Salma Jaya has significantly affected employee productivity and product quality. Workforce adaptability challenges during machine breakdowns led to inconsistencies in product texture and moisture levels, causing customer dissatisfaction and reduced repeat orders. Root Cause Analysis (RCA) and the Fishbone Diagram identified key issues such as

inadequate employee training, frequent machine failures, inconsistent raw materials, ineffective manual techniques, and an unsupportive work environment. The Analytic Hierarchy Process (AHP) study posits that the most efficacious long-term strategy for enhancing output, ensuring product uniformity, and mitigating breakdowns is to invest in a new machine equipped with reliable automation technology. The maintenance of operational efficiency and corporate competitiveness necessitates not only technological investment, but also the implementation of enhanced preventative maintenance methodologies, more stringent raw material quality control measures, and targeted personnel training. The present study has several shortcomings. Firstly, it focuses exclusively on a single organization, which may be considered a limitation. Secondly, there is a possibility of bias in AHP weight estimates. Thirdly, a financial feasibility analysis for machinery investment is absent. It is recommended that future studies examine more extensive manufacturing settings, including financial analyses, and gauge how well employee training initiatives are working. Furthermore, research into Industry 4.0 technologies, such as IoT-enabled monitoring and predictive maintenance, may offer more profound insights into maximizing operational effectiveness and lowering downtime risks.

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