INKUBIS: Jurnal Ekonomi dan Bisnis
Volume 8, Issue 2, 1221-1237
e_ISSN: 2775-3913
https://inkubis.polteksci.ac.id/index.php/ink/index
DOI: doi.org/10.59261/inkubis.v8i2.329

A Customized Production Performance Model Based on Preparation, Discipline, Compactness, and Cleanliness in a Bentonite Plant

***Agustinus Hariadi Djoko Purwanto**
Universitas Mercu Buana, Indonesia

Mohammad Fazli Sabri
Universiti Putra Malasyia, Malaysia

Sri Hartono
Universitas Mercu Buana, Indonesia

***Corresponding author:**
Agustinus Hariadi Djoko Purwanto,
Universitas Mercu Buana, Indonesia.
✉agustinus.hariadi@mercubuana.ac.id

Article Info:
Article history:
Received: May 29, 2026
Revised: July 22, 2026
Accepted: July 24, 2026

Keywords:
Bentonite; Cleanliness; Compactness; Consistency; Discipline; Preparation; Production Performance

Abstract

Background: A bentonite plant producing high-performance bleaching earth faces challenges in competition due to its decreasing level of production effectiveness and efficiency including increasing reports of non-conforming products, defected products and reduced production volume. Realizing the factory have applying 5S to prevent and handle such problems, a customized model extracted from the 5S is proposed.
Objective: This research examines the proposed operation management model for which the production is capable to conform with planned quality and quantity as well as preventing rejects.
Methods: The model is structured from Preparation simultaneously affects Discipline, Compactness and Cleanliness. Subsequently, the three-process management improves implementation consistency from which production effectiveness is attained. This is a quantitative study in which data collected from 140 respondents and analyzed using PLS software.
Results: The results reveals that Preparation affects Discipline, Compactness, and Cleanliness at values of 0.685, 0.695, and 0.621 respectively. Discipline increases Implementation consistently at a value of 0.329, Compactness at 0.267 and Cleanliness at 0.233. Finally, the implementation consistency increases production performance at 0.717. In summary, the customized model is fit to be implemented for recovering the plant's production performance.
Conclusion: The proposed customized model derived from the 5S framework is validated and demonstrates strong applicability for recovering production performance in a bentonite plant. Theoretically, this study contributes a structured cause-effect model linking preparation, discipline, compactness, and cleanliness to implementation consistency and production effectiveness. Practically, plant managers are provided a field-tested, quantitatively validated framework for systematic improvement of production operations.

To cite this article: Purwanto, A. H. D., Sabri, M. F., & Hartono, S. (2026). A customized production performance model based on preparation, discipline, compactness, and cleanliness in a bentonite plant. INKUBIS: Jurnal Ekonomi dan Bisnis, 8(2). https://doi.org/10.59261/inkubis.v8i2.329

INTRODUCTION

Production effectiveness has become a major source of competitive advantage in manufacturing industries because it determines product quality, production capacity, operational efficiency, and customer satisfaction (Goshime et al., 2019; Ramlawati et al., 2018; Suseno et al., 2023). In chemical manufacturing, production processes require strict operational control since deviations during processing frequently result in excessive waste generation, off-specification products, repeated processing, equipment downtime, and increased production costs (Halim & Srinivasan, 2006; Nikolopoulou & Ierapetritou, 2012; Stoessel, 2020). Consequently, manufacturing companies continuously seek operational management approaches capable of improving production consistency while simultaneously reducing process variation and production losses (Alves & Alves, 2015; Hartnett et al., 1988; Schmenner & Swink, 1998).

The bentonite plant investigated in this study is one of the production facilities of a multinational company producing high-performance bleaching earth. During the last several years, however, the plant has experienced declining production effectiveness despite implementing standard operational and quality management practices. Internal production monitoring indicates increasing wastewater generation, repeated cleansing and mixing processes, equipment leakage, production interruptions, and decreasing production output. These operational problems have reduced production efficiency and increased manufacturing costs, thereby threatening the plant's ability to achieve its production targets.

The increasing operational inefficiency is reflected in the growth of wastewater generation accompanying higher fresh-water consumption, as illustrated in Figure 1. This trend indicates that production processes have become less efficient and generate larger quantities of waste than the company's operational standards.

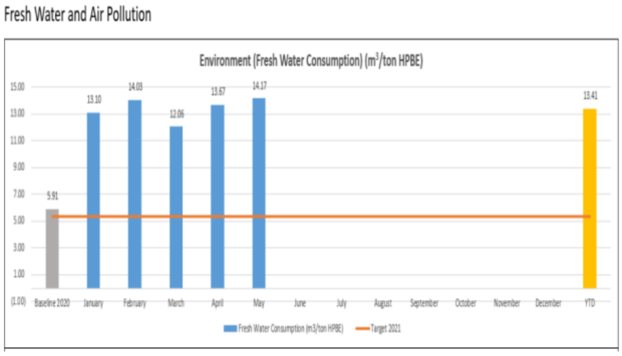

Figure 1. Waste generation above Plant's Standard
Source: Internal Production and Quality Report of the Bentonite Plant (2021), processed by the authors.

Besides increasing waste generation, the plant has also experienced a gradual decline in production capacity. Figure 2 shows that actual production has continuously decreased during the last three years and has fallen below the production targets established by the company. Such conditions indicate that existing operational practices have not been sufficiently effective in maintaining production stability.

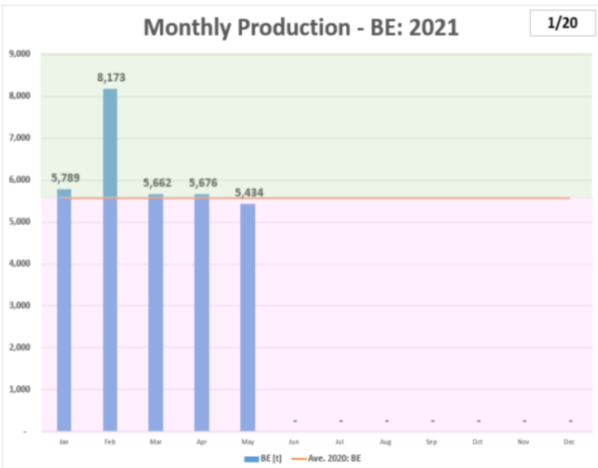

Figure 2. Production Capacity Reduction
Source: Internal Production and Quality Report of the Bentonite Plant (2021), processed by the authors.

Quality-related problems further strengthen the need for operational improvement. Figure 3 illustrates that rejected products caused by quality defects, pH deviations, and acid parameter failures dominate the rework activities within the plant. These non-conforming products not only increase production costs but also reduce production efficiency because additional processing time and resources are required to recover product quality.

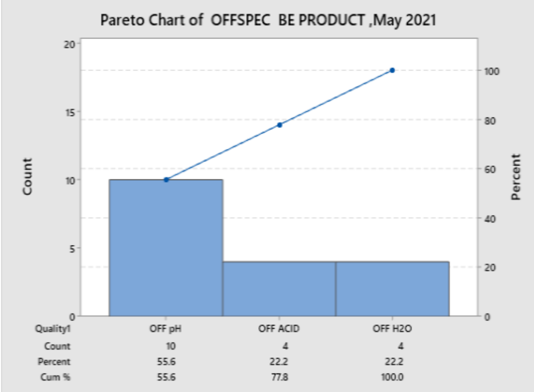

Figure 3 Offspecification of the Bentonite
Source: Internal Production and Quality Report of the Bentonite Plant (2021–2025), processed by the authors.

To overcome these operational problems, management has strengthened quality management practices through corrective actions, internal quality audits, visual management, and implementation of the 5S methodology. Nevertheless, production effectiveness has not consistently reached the expected level, suggesting that successful implementation depends not merely on adopting 5S practices but also on understanding how the operational dimensions interact to create sustainable production consistency.

Previous studies have demonstrated that the 5S methodology improves workplace organization, operational efficiency, and manufacturing productivity (Monnanyana & Gupta, 2021; Omogbai & Salonitis, 2017; Sabah et al., 2023). Most existing studies, however, evaluate 5S as an integrated workplace management system or report implementation outcomes descriptively. Limited attention has been given to examining the causal relationships among the individual operational dimensions that collectively determine implementation consistency and production performance, particularly in chemical manufacturing environments.

This limitation constitutes the research gap addressed in the present study. Unlike previous studies that evaluate 5S as a complete management practice, this research develops a customized production performance model by restructuring selected operational components of the 5S framework into measurable latent constructs consisting of Preparation, Discipline, Compactness, Cleanliness, Implementation Consistency, and Production Performance. The proposed model explains the sequential relationships among these constructs and empirically validates their influence using Partial Least Squares Structural Equation Modeling (PLS-SEM). This approach provides a more comprehensive explanation of how operational preparation establishes implementation consistency and ultimately improves production effectiveness.

Therefore, this study aims to examine the structural relationships among Preparation, Discipline, Compactness, Cleanliness, Implementation Consistency, and Production Performance in a bentonite manufacturing plant using PLS-SEM. The findings are expected to contribute theoretically by extending the operational management literature through a causal interpretation of 5S implementation and practically by providing manufacturing managers with an empirically validated framework for improving production effectiveness in chemical manufacturing industries.

Literature Review

Theoretical Framework and Hypothesis Development

This study proposes an improvement production model extracted from process management contained in 5S by structuring into cause-effect relationship by which a more control and associated results are better comprehended and adjusted accordingly.

The frame of thought of the research is to know effect of production preparation simultaneously to shop floor practices which are discipline, compactness, cleanliness after which the process management simultaneously influence implementation consistency. Consequently, operation performance in terms of increasing conformances of quality and quantity of processes and product and minimization of product rejects.

The following figure showing the model to be examined.

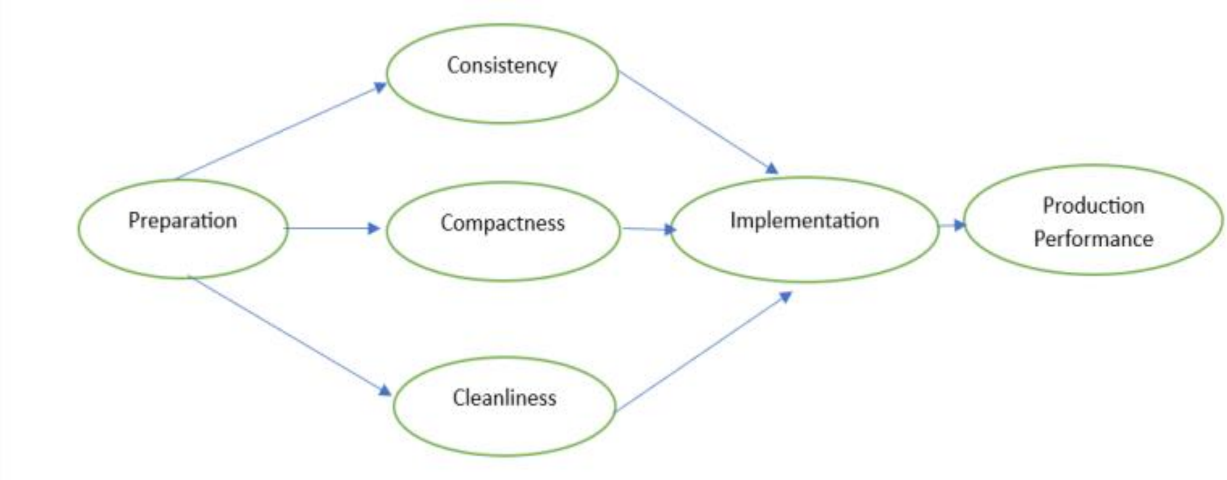

Figure 4. Frame of Thought

Monnanyana & Gupta (2021) investigated effect of preparation to compactness and tidiness revealing significant influence, whilst Michalska & Szewieczek (2007) reported that preparation increase practice discipline in shop floor. The two studies provides this research with hypothesis 1, 2 and 3 in that Preparation affects Discipline, Compactness and Cleanliness. Discipline in following procedures means consistent in carrying any jobs. Compact area, machinery and transport causes quicker execution with less mistakes . Cleanliness too preventing from operation incidents both in term of quality and safety. Purwanto et al. (2022) explored correlation between consistency implementation and production performance with a result of strong correlation. This is used as the basis for hypothesis 7.

The 7 (seven) hypothesis is written down as follow:

H1: Preparation affects Discipline.
H2: Preparation affects Compactness.
H3: Preparation affects Cleanliness.
H4: Discipline affects Implementation consistency.
H5: Compactness affects Implementation consistency.
H6: Cleanliness affects Implementation consistency.
H7: Implementation consistency affects Production Performance.

METHODS

The primary data in this study were obtained through questionnaires administered both offline and online using Google Forms. A Likert scale was employed to measure the research variables, in which respondents were asked to indicate their degree of agreement or disagreement regarding the measured variables. The scale ranged from 1 to 5, representing responses from very low to very high.

This research employed purposive sampling from a population consisting of all employees. The inclusion criteria for the sample were operators, group leaders, and supervisors involved in production, maintenance, and quality control activities. A total of 140 respondents participated in this study. Hair et al. (2019) recommends that the sample size should be 5–10 times the number of indicators. With 17 indicators in this study, the recommended minimum sample size ranges from 85 to 170 respondents (17 × 5 = 85; 17 × 10 = 170). Therefore, the obtained sample of 140 respondents falls within the acceptable range. Data collection was conducted over a three-month period, with an 89% response rate. To control for respondent bias, the questionnaires were administered anonymously during regular shift briefings.

The study examines six latent variables and 17 measurement indicators. The following operationalization of variables is intended to facilitate and guide questionnaire development.

The first "S," *Sort*, focuses on eliminating unnecessary items from the factory environment. Monnanyana & Gupta (2021) stated that the second "S," *Set in Order*, focuses on creating a visually informative and orderly workplace. This implementation involves organizing the workplace by identifying and marking all necessary locations through the creation of designated addresses or locations, allocation of labels, placement markings, and the application of color coding systems within the factory.

Monnanyana & Gupta (2021) explained that the third "S," *Shine*, focuses on removing dirt and other debris. This means that all equipment and workplace areas need to be inspected regularly to eliminate sources of contamination. The targeted outcome is a clean workplace that maintains proper conditions and minimizes contamination sources. This objective is achieved by determining cleaning requirements and establishing appropriate cleaning methods.

Monnanyana & Gupta (2021) stated that the fourth "S," *Standardize*, focuses on establishing necessary standards to maintain all improvements achieved through the *5S* methodology. The targeted outcomes include developing procedures, required checklists, and supporting mechanisms to maintain a visually organized working environment. This is achieved by agreeing upon standardized practices and implementing *5S* rules. Figure 4 illustrates the importance of standardization within the factory.

Monnanyana & Gupta (2021) described that the fifth "S," *Sustain*, focuses on monitoring, expanding, and refining all results obtained during the implementation process. The targeted outcome is a workplace or factory environment capable of restoring order automatically, regulating itself, and continuously improving through sustainable practices.

This research extracts the construct of preparation from the *5S* methodology. Gupta & Jain (2015) stated that *5S* is a methodology for creating and maintaining well-organized, clean, highly effective, and high-quality workplaces. The authors further suggested that introducing *5S* principles brings significant changes to companies, such as process improvement through cost reduction, increased effectiveness and efficiency, maintenance and improvement of machine performance, improved safety, reduction of industrial pollution, and adherence to established procedures and decisions.

Preparation (X1)

Preparation establishes the foundation for Discipline, Compactness, and Cleanliness, which subsequently contribute to achieving consistent implementation (*Sustain* in the *5S* methodology). Consistency (sustainment) can be achieved through Discipline enabled by adequate Preparation, such as fostering employee engagement, providing continuous training, and establishing accountability mechanisms (Daraei et al., 2015). Without proper Preparation, sustaining *5S* practices (implementation consistency) becomes challenging, and the benefits achieved may only be temporary. Adequate Preparation ensures that each subsequent phase is executed effectively, leading to improved workplace organization, operational efficiency, and safety.

By emphasizing Preparation in terms of personnel, procedures, and specifications, the factory can enhance the effectiveness and sustainability of its consistency model (*5S*) initiatives. Monnanyana & Gupta (2021) reported that the absence of *5S* practices, including Preparation, Discipline, Compactness, Cleanliness, and Consistency, has resulted in disorder and chaotic conditions within factories. Such conditions include insufficient tools in toolboxes, untidy workstations, unclean working areas, and irregular maintenance activities or inconsistent practices during shift changes. These issues can be prevented when personnel are adequately prepared through awareness training, standardized procedures, and clearly defined requirements.

Preparation begins with providing trained personnel who understand the required tasks and procedures to be followed as guidelines for performing assigned duties (Gupta & Jain, 2015). The quality of activities is achieved through clearly specified procedures that are properly executed by personnel. Accordingly, Preparation is defined as an activity to determine the details of future activities aimed at achieving operational targets. In this study, Preparation is represented by three indicators: trained personnel (X1.1), provided procedures (X1.2), and defined specifications (X1.3).

Discipline (X2)

Process consistency is closely related to personnel discipline. Discipline refers to routine practices that are performed consistently in terms of sequence, timing, and measurement (Daraei et al., 2015). Discipline is demonstrated through the establishment of criteria that serve as references for both processes and personnel. Through these criteria, materials, machines, and tools can be consistently arranged according to predetermined standards. This requires consistent labeling practices as visual management guidelines.

Discipline is fundamental to the successful adoption and maintenance of organizational practices. By developing a culture of discipline, organizations can improve manufacturing effectiveness, achieve sustainable workplace improvements, enhance operational efficiency, and promote continuous improvement and excellence. This concept is closely related to *Standardize* in the *5S* methodology, as Purwanto & Hartono (2022) explained that standardization involves developing and implementing standards in the form of procedures and instructions that enable workplace order to be maintained.

From this perspective, this study defines Discipline as an activity to ensure that operational activities are performed according to established criteria to achieve production targets. Discipline consists of the following indicators: sorting criteria followed (X2.1), consistent placement (X2.2), and labeling compliance (X2.3).

Compactness (X3)

Compactness in manufacturing is closely aligned with the principles of the Consistency model derived from the *5S*methodology (Monnanyana & Gupta, 2021). It promotes operational efficiency, workplace safety, visual management, and sustainability. By incorporating compactness into daily operational practices, factories can establish work environments that support productivity, quality improvement, and continuous improvement. Sabah et al. (2023) stated that compact operations improve workflow smoothness and reduce processing time.

Compactness can be regarded as the effective utilization of available factory space and, from a safety perspective, involves removing hazardous obstacles that may create risks (Triana & Lesmana, 2020). Michalska & Szewieczek (2007) associated compactness with the *Sort* principle in *5S*, defining it as workplace organization and the elimination of unnecessary materials. The authors emphasized the importance of sorting tools and materials within work areas by retaining only essential items, while unnecessary items should be stored appropriately or discarded.

Therefore, in this study, Compactness is defined through three indicators: established compact perimeter (X3.1), compact operational sequence (X3.2), and recorded activities (X3.3).

Cleanliness (X4)

Cleanliness represents the closest concept to *Shine* within the *5S* methodology. Regular cleaning activities enable organizations to identify and eliminate sources of disorder while maintaining a clean workplace environment. Cleaning activities include inspecting the condition of machines, workplaces, floors, equipment tightness, production lines, pipelines, lighting sources, data availability, information clarity, and other operational elements. Michalska & Szewieczek (2007) stated that cleanliness practices involve restoring workplace conditions through daily activities aimed at maintaining a faultless level of cleanliness.

Cleanliness is a critical component of the Consistency model and supports its primary objectives of safety, efficiency, and workplace organization. By incorporating cleanliness practices into daily production activities, factories can create work environments that support productivity, product quality, and employee well-being (Daraei et al., 2015). In this study, Cleanliness is represented by three indicators: clean products and work areas (X4.1), installed and clean machines (X4.2), and clean incoming raw material areas (X4.3).

Implementation Consistency (Y)

Business competitive advantage is supported by the ability of organizations to consistently provide products or services through reliable and standardized processes (Triana & Lesmana, 2020). Michalska & Szewieczek (2007) stated that implementing *5S* requires strong self-discipline associated with following regular cleaning (*Shine*) and sorting (*Sort*) practices. These practices increase employee awareness, reduce non-conforming products and processes, improve internal communication, and strengthen human relations within organizations.

Consistency requires the execution of routine inspections to ensure compliance with factory rules and operational standards (Triana & Lesmana, 2020). In this study, Implementation Consistency is measured through three indicators: practices consistently following procedures (Y1), rejected products consistently separated (Y2), and processes matching established guidelines (Y3).

Production Effectiveness (Z)

Good production performance indicates that both production quantity and quality continuously meet or exceed predetermined targets. In this context, Michalska & Szewieczek (2007) highlighted several advantages of implementing *5S* principles, including process improvement through cost reduction, inventory reduction, better utilization of workplace areas, prevention of tool losses, increased process effectiveness and efficiency, reduced time required to locate necessary items, improved workplace safety, increased machine efficiency, improved equipment maintenance, maintained workplace cleanliness, easier identification of problems, faster detection of potential damage sources, improved working conditions, elimination of accident causes, reduction of industrial pollution, development of standardized procedures, increased employee awareness and morale, reduced errors caused by negligence, improved decision-making processes, enhanced internal communication, and improved interpersonal relationships (Purwanto & Hartono, 2022; Triana & Lesmana, 2020).

Monnanyana & Gupta (2021) aimed to improve productivity and efficiency by reducing factory disorder, minimizing time spent searching for tools and materials, and arranging workplaces to improve visibility of machines, equipment, and materials. The post-implementation results confirmed that *5S* implementation effectively improved factory workplace organization, reduced the time required to identify, access, and locate tools and other items, and enhanced the visibility of tools, equipment, and materials.

These improvements contribute to the overall enhancement of company productivity and efficiency (Sabah et al., 2023). In this study, Production Effectiveness is defined as a factory operational performance indicator consisting of three dimensions: quality conformity (Z1), quantity conformity (Z2), and reduced rejection rates (Z3).

RESULTS AND DISCUSSION

Results

The data were compiled from surveys administered to respondents working in the chemical factory. Table 1 presents the percentage of responses within the categories “agree” and “strongly agree.” The other three response categories in the questionnaire (“neutral,” “disagree,” and “strongly disagree”) are not included in the table because they were left blank by the respondents.

Analysis Using PLS-SEM

Considering the structured model and the dataset containing respondents’ perspectives, Partial Least Squares Structural Equation Modeling (PLS-SEM) was considered the most suitable analytical approach for hypothesis testing. The following section describes the stages of the related analysis.

Measurement Model Assessment

The measurement model was evaluated to determine its compatibility and the significance of correlations among the variables that constitute the model. The assessment included validity and reliability testing of the outer model (measurement model), evaluation of the inner model (structural model), and significance testing among latent variables.

Validity Test: Outer Model Evaluation

The outer model assessment aims to determine the validity and reliability of the measurement model. The validity test consists of convergent validity and discriminant validity assessments.

Convergent validity measures the extent to which reflective indicators represent their respective latent constructs through measurable indicator variables, as reflected by the outer loading values. The acceptance criteria indicate that the loading factor should be > 0.70 and the Average Variance Extracted (AVE) value should be > 0.50.

Regarding discriminant validity, the measurement model is considered valid when the cross-loading value is > 0.70.

Table 1. Original Outer Loading

Indicator	Outer Loading						Status
	X1	**X2**	**X3**	**X4**	**Y**	**Z**	
X1.1	X1.1	0.730					Valid
X1.2	X1.2	0.821					Valid
X1.3	X1.3	0.821					Valid
X2.1	X2.1		0,828				Valid
X2.2	X2.2		0,879				Valid
X2.3	X2.3		0,892				Valid
X3.1	X3.1			0,865			Valid
X3.2	X3.2			0,847			Valid
X3.3	X3.3			0,768			Valid
X4. 1	X4.1				0,785		Valid
X4.2	X4.2				0,875		Valid
X4.3	X4.3				0,778		Valid
	Y1					0,833	Valid
	Y2					0,774	Valid
	Y3					0,858	Valid
Y.1	Z1						Valid
Y.2	Z2						Valid
Y.3	Z3						Valid
Z.1	X1.1	0.730					Valid
Z.2	X1.2	0.821					Valid
Z.3	X1.3	0.821					Valid

It shows that the 20 indicators have met the validity criteria.

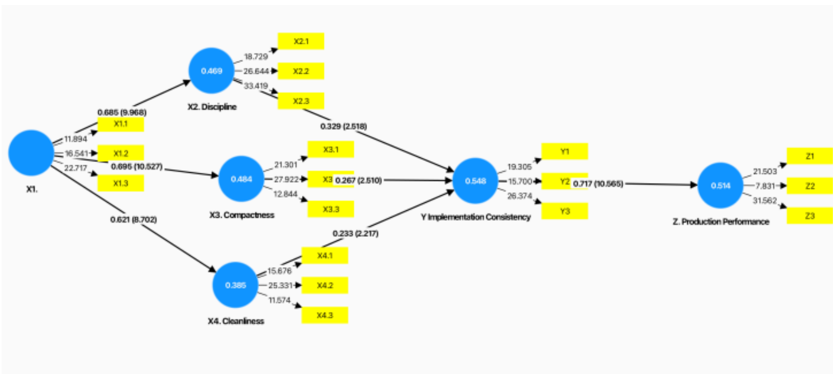

Figure 5. Path Diagram Based on Loading Factor

The discriminant validity calculation is provided in the following table.

Table 2. Convergent Validity After Revision Crossloading

Indikcator	X1	X2	X3	X4	Y1	Z

X1.1	0,730	0,438	0,534	0,412	0,504	0,608
X1.2	0,821	0,540	0,603	0,463	0,730	0,602
X1.3	0,821	0,631	0,519	0,586	0,613	0,509
X2.1	0,549	0,828	0,616	0,595	0,539	0,551
X2.2	0,611	0,879	0,543	0,679	0,595	0,641
X2.3	0,617	0,892	0,631	0,659	0,645	0,595
X3.1	0,583	0,554	0,865	0,528	0,552	0,617
X3.2	0,624	0,600	0,847	0,562	0,521	0,639
X3.3	0,516	0,553	0,768	0,502	0,525	0,542
X4.1	0,537	0,549	0,493	0,785	0,505	0,419
X4.2	0,514	0,725	0,610	0,875	0,532	0,508
X4.3	0,463	0,541	0,461	0,778	0,550	0,515
Y.1	0,661	0,528	0,495	0,464	0,829	0,596
Y.2	0,588	0,541	0,555	0,543	0,775	0,592
Y.3	0,678	0,619	0,533	0,590	0,860	0,580
Z.1	0,648	0,577	0,596	0,551	0,603	0,846
Z.2	0,422	0,442	0,444	0,398	0,483	0,718
Z.3	0,649	0,636	0,700	0,482	0,645	0,862

It shows that the cross-loading values of each variable has higher value that 0.7 within a range of 0.748 to 0.932. Therefore, all indicators have met the criteria.

Validity Test: Discriminant Using Average Variance Extracted (AVE)

The criteria is that AVE value > 0.5 to have good model.

Tabel 3 Value of (AVE)

	Average Variance Extracted (AVE)
X1 Preparation	0,627
X2 Discipline	0,751
X3 Compactness	0,685
X4 Cleanliness	0,663
Y Implementation Consistency	0,676
Z Production Effectiveness	0,658

In the table, it shows all indicator have AVE value higher than 0.5. In other word, all variable has good/adequate discriminant variable.

Reliability Test

Latent variable with good reliability is when their composite reliability at Cronbach alpha value higher than 0,7 (Sarwono & Narimawati, 2015).

Tabel 4. Composite Realibility & Cronbach's Alpha

Variabel	**Cronbachs Alpha**	**Composite Reliability**	**Status**
X1 Preparation	0,702	0,712	Reliable
X2 Discipline	0,834	0,840	Reliable
X3 Compactness	0,769	0,773	Reliable
X4 Cleanliness	0,743	0,744	Reliable
Y Implementation Consistency	0,759	0,761	Reliable
Z Production performance	0,739	0,759	Reliable

The table reveals that all variable has composite reliability higher than 0,6 in the range between 0.865 – 0.913 as well as has Cronbach alpha value in the range of 0.702 to 0.834. Therefore, all variable has good reliability.

Inner Model (Structural Model) Evaluation

Determination Coefficient (R^2) is used to show how much effect or influence of independent variable to dependent variable. The R-Square of the model is presented below.

Tabel 5 R-Square Value

Variabel	R Square	R squate adjusted
X1 Preparation		
X2 Discipline	0,469	0,463
X3 Compactness	0,483	0,478
X4 Cleanliness	0,385	0,379
Y Implementation Consistency	0,549	0,535
Z Production performance	0,514	0,509

Hypothesis Test

The Hypothesis 1 to 7 as discussed above determines whether there are influences from one variable to another in the model. The hypothesis test uses t value as the criteria to determine significance of the correlation in which it is statistically significant when the t values > 1.96. The testing results is as follows:

Tabel 6 Hypothesis Test Result

H	Correlation	PC	TS	Result
H1	Preparation > Discipline	0,685	9,968	+&S
H2	Preparation > Compactness	0,695	10,527	+&S
H3	Preparation > Cleanliness	0,621	8,702	+&S
H4	Discipline > Implementation consistency	0,329	2,518	+&S
H5	Compactness > Implementation consistency	0,267	2,510	+&S
H6	Cleanliness > Implementation consistency	0,233	2,217	+&S
H7	Implementation consistency > Production performance	0.717		+&S

Note: H= Hypothesis; PC = Patch coefficient; TS = t Statistic; Result = += positive/- direction; S= Significance

Discussion

The discussion in this section is arranged according to the internal model, which illustrates the latent variables and their influence pathways. Preparation is foundational to the successful implementation and sustainability of other process management activities, including discipline, compactness, cleanliness, implementation consistency, and operational effectiveness. It enables effective implementation, initiates discipline, facilitates compactness, and supports cleanliness. Before initiating these three activities, comprehensive preparation is required. This includes ensuring personnel competency through training and providing procedures with clear specifications (Purwanto et al., 2022).

The preparation plan covers an approach for identifying and removing unnecessary items from the workplace. It requires careful assessment and categorization of items based on their necessity. Adequate preparation ensures that this sorting process is systematic and effectively executed. Preparation also focuses on organizing essential items in a structured and efficient manner. Effective preparation, including layout planning, determination of storage solutions, and establishment of labeling systems, provides a foundation for workplace organization. Without adequate preparation, the compactness phase may result in disorganized or inefficient arrangements. Similarly, maintaining workplace cleanliness and hygiene is essential. Preparation involves establishing cleaning schedules, assigning responsibilities, and providing the necessary cleaning equipment and supplies.

Preparation to Discipline

Figure 6. An example of Rework Product and Placement
Source: Internal Production and Quality Report of the Bentonite Plant, processed by the authors.

The structural model demonstrates that Preparation has a positive and significant effect on Discipline (β = 0.685; t = 9.968), indicating that adequate operational preparation is a prerequisite for disciplined execution of production activities. This result suggests that employee training, clearly documented operating procedures, and well-defined production specifications establish a shared operational understanding that encourages workers to perform production tasks consistently according to established standards. In the investigated bentonite plant, where production inefficiencies were reflected in increasing rejected products, repeated processing, and declining production capacity, proper preparation reduces ambiguity in daily operations and strengthens compliance with standard operating procedures.

Among the three operational dimensions influenced by Preparation, Discipline represents employees' commitment to consistently applying sorting criteria, appropriate equipment placement, and standardized work practices during production activities. The relatively high path coefficient indicates that workforce readiness contributes substantially to disciplined behavior on the production floor. When operators fully understand production specifications and receive adequate procedural guidance, deviations caused by inconsistent work practices can be minimized, thereby improving operational reliability.

This finding is consistent with Daraei et al. (2015), who argued that organizational readiness through employee preparation is essential for sustaining operational improvement initiatives. Likewise, Michalska & Szewieczek (2007) emphasized that standardized work procedures become effective only when employees consistently follow them through disciplined execution. However, the present study extends previous 5S research by empirically demonstrating that Preparation functions not merely as an initial implementation stage but as the principal antecedent of Discipline within a structural production performance model. Rather than treating preparation as an independent managerial activity, this study confirms that it directly strengthens employees' operational discipline, which subsequently supports implementation consistency and production performance.

Preparation to Compactness

The structural model indicates that Preparation has a positive and significant effect on Compactness (β = 0.695; t = 10.527), representing the strongest relationship among the three operational dimensions influenced by Preparation. This finding suggests that adequate preparation plays a critical role in establishing an organized production environment by ensuring that personnel are properly trained, operational procedures are clearly documented, and production specifications are well defined before production activities commence. Such preparation enables employees to arrange workstations, equipment, and material flows systematically, thereby minimizing unnecessary movement and improving workflow efficiency.

In the context of the investigated bentonite plant, compactness is particularly important because the production process involves multiple sequential operations requiring coordinated movement of raw materials, intermediate products, and processing equipment. The operational problems identified in the plant, including repeated processing, equipment leakage, production interruptions, and declining production output, indicate that inefficient workplace organization can increase process variability and reduce operational efficiency. The strong path coefficient demonstrates that effective preparation provides employees with sufficient understanding of production layouts, equipment positioning, and workflow arrangements, allowing production activities to be performed in a more structured and efficient manner. Consequently, unnecessary operator movement, delays in material handling, and process interruptions can be reduced.

This result supports the findings of Sabah et al. (2023), who reported that effective workplace organization improves production flow by reducing unnecessary activities and facilitating smoother manufacturing operations. Similarly, Gupta & Jain (2015) argued that proper planning and standardized workplace arrangements enable organizations to utilize available space more efficiently while improving process effectiveness. However, the present study extends previous research by demonstrating that compactness is not achieved solely through workplace organization practices but is largely determined by the quality of operational preparation undertaken before implementation. This empirical evidence suggests that preparation serves as the organizational foundation that enables compact workplace arrangements to be established consistently, thereby supporting the sustainable implementation of the customized production performance model in the bentonite manufacturing environment.

Preparation to Cleanliness

The structural model demonstrates that Preparation has a positive and significant effect on Cleanliness ($\beta = 0.621$; $t = 8.702$), indicating that operational cleanliness is strongly influenced by the extent to which production activities are adequately prepared before execution. Although the effect is slightly lower than that of Preparation on Compactness and Discipline, the result confirms that employee readiness, standardized procedures, and clearly defined production specifications provide an essential foundation for maintaining a clean and controlled production environment.

This finding is particularly relevant to the operational conditions of the investigated bentonite plant, where increasing wastewater generation, repeated cleaning processes, equipment leakage, and off-specification products were identified as major operational problems. These conditions indicate that workplace cleanliness is not merely a housekeeping function but an integral component of process control in chemical manufacturing. Adequate preparation enables employees to understand cleaning responsibilities, equipment inspection procedures, material handling requirements, and contamination prevention measures before production begins. Consequently, production areas, machines, and raw material storage areas can be maintained more systematically, reducing contamination risks and minimizing process disruptions that may lead to product defects and production losses.

The significant relationship also suggests that cleanliness depends on proactive operational planning rather than corrective actions after problems occur. When cleaning procedures are incorporated into production planning and supported by appropriate training and operational standards, employees are more likely to perform routine cleaning and inspection activities consistently. Such preventive practices contribute to maintaining stable production conditions and support the continuous implementation of standardized operating procedures throughout the production process.

These findings are consistent with Michalska & Szewieczek (2007), who emphasized that workplace cleanliness is essential for maintaining standardized operations and preventing process deviations. Similarly, Monnanyana & Gupta (2021) reported that effective implementation of workplace management practices improves operational orderliness and reduces production inefficiencies through systematic housekeeping activities. However, the present study extends previous research by demonstrating that cleanliness is primarily driven by operational preparation rather than by cleaning activities alone. The empirical evidence indicates that preparation establishes the organizational capability required to sustain workplace cleanliness, which subsequently supports implementation consistency and contributes indirectly to improved production performance in the bentonite manufacturing plant.

Discipline To Implementation Consistency

The hypothesis testing results indicate that Discipline has a positive and significant effect on Implementation Consistency (β = 0.329; t = 2.518). Among the three operational dimensions contributing to implementation consistency, Discipline exhibits the strongest direct effect, indicating that employees' compliance with standardized work practices is the most influential factor in ensuring that production procedures are executed consistently. This finding suggests that implementation consistency depends primarily on employees' ability to perform production activities according to established operational standards rather than relying solely on workplace organization or cleanliness.

In the investigated bentonite plant, operational problems such as repeated processing, production interruptions, and increasing rejected products indicate that variations in employees' work practices can directly reduce production stability. The significant effect of Discipline demonstrates that when operators consistently follow sorting criteria, maintain standardized equipment placement, and comply with operational procedures, production activities become more predictable and less susceptible to process deviations. As a result, implementation consistency can be maintained across production shifts, reducing operational variability and supporting more reliable production outcomes.

The relatively higher path coefficient compared with Compactness (β = 0.267) and Cleanliness (β = 0.233) further indicates that human behavior plays a more decisive role than physical workplace conditions in sustaining consistent implementation. Although workplace organization and cleanliness provide an enabling production environment, their effectiveness ultimately depends on employees' willingness and ability to apply operational standards consistently. This finding highlights that production consistency is fundamentally a behavioral issue requiring continuous commitment to standardized operating procedures rather than depending exclusively on physical improvements to the workplace.

The present findings are consistent with Michalska & Szewieczek (2007), who argued that standardized work practices can only be sustained through disciplined employee behavior. Similarly, Gupta & Jain (2015) reported that adherence to standardized operating procedures reduces process variability and improves operational reliability. However, the current study extends previous 5S research by providing empirical evidence that Discipline represents the most influential operational behavior driving implementation consistency within the proposed customized production performance model. Rather than being viewed solely as one component of the 5S methodology, Discipline is demonstrated to function as the principal behavioral mechanism through which operational standards are translated into consistent production practices, ultimately supporting improved production performance in the bentonite manufacturing plant.

Compactness To Implementation Consistency

The hypothesis testing results demonstrate that Compactness has a positive and significant effect on Implementation Consistency (β = 0.267; t = 2.510). Although the magnitude of the effect is lower than that of Discipline, the findings indicate that an organized workplace layout contributes significantly to maintaining the consistent execution of production activities. This result suggests that the systematic arrangement of work areas, equipment, material flows, and production sequences creates an operational environment that enables employees to follow standardized procedures more efficiently and with fewer process deviations.

In the investigated bentonite plant, production activities involve sequential processing stages that require continuous movement of raw materials, intermediate products, and finished products across different workstations. The operational issues identified in the plant, including repeated processing, production interruptions, and declining production output, imply that inefficient workplace organization can increase unnecessary movement, delay material handling, and create inconsistencies during production. The significant relationship found in this study indicates that improving workplace compactness reduces operational complexity and facilitates smoother execution of standardized production procedures, thereby strengthening implementation consistency.

Compared with Discipline (β = 0.329), the smaller coefficient of Compactness (β = 0.267) suggests that workplace organization primarily serves as an enabling operational condition rather than the principal driver of consistent implementation. A well-organized production layout allows operators to access equipment and materials more efficiently; however, the resulting operational benefits can only be realized when employees consistently comply with established procedures. Therefore, Compactness complements disciplined work behavior by minimizing physical barriers that may otherwise hinder the consistent execution of production activities.

These findings support the study of Sabah et al. (2023), who reported that effective workplace organization improves production flow by reducing unnecessary movement and enhancing operational efficiency. Likewise, Gupta & Jain (2015) demonstrated that systematic workplace arrangement contributes to standardized production processes and reduces operational waste. However, the present study extends previous research by empirically confirming that Compactness contributes indirectly to production performance through its significant influence on Implementation Consistency. Rather than affecting production outcomes directly, workplace organization strengthens process stability, enabling standardized procedures to be executed more consistently within the bentonite manufacturing environment.

Cleanliness To Implementation Consistency

The hypothesis testing results indicate that Cleanliness has a positive and significant effect on Implementation Consistency ($\beta = 0.233$; $t = 2.217$). Although this relationship represents the smallest path coefficient among the three antecedents of Implementation Consistency, the findings confirm that workplace cleanliness remains an important operational factor in ensuring that standardized production procedures are implemented consistently. This result suggests that maintaining a clean production environment supports process stability by reducing operational disturbances that may interfere with routine production activities.

The operational conditions observed in the investigated bentonite plant provide a practical explanation for this relationship. The plant experienced increasing wastewater generation, equipment leakage, repeated cleaning activities, and off-specification products, indicating that production cleanliness is closely associated with process reliability. In chemical manufacturing, contamination of production areas, processing equipment, or raw material storage areas can interrupt production flow, increase product defects, and require additional rework. Therefore, maintaining cleanliness through routine equipment inspections, systematic housekeeping, and proper handling of production materials enables employees to perform standardized operating procedures more consistently while minimizing unexpected operational deviations.

Compared with Discipline ($\beta = 0.329$) and Compactness ($\beta = 0.267$), the relatively smaller coefficient of Cleanliness indicates that workplace cleanliness functions primarily as a supporting operational condition rather than the principal determinant of implementation consistency. Nevertheless, its significant contribution demonstrates that stable production performance cannot be achieved without maintaining clean production facilities. Even highly disciplined employees working in well-organized production areas may experience operational inconsistencies when contamination, equipment residue, or poor housekeeping disrupt normal production activities. Consequently, Cleanliness complements disciplined work behavior and workplace organization by providing an operational environment that supports uninterrupted implementation of standardized procedures.

These findings are consistent with Michalska & Szewieczek (2007), who emphasized that workplace cleanliness is essential for sustaining standardized operations and preventing process irregularities. Similarly, Monnanyana & Gupta (2021) reported that effective implementation of 5S improves workplace organization and operational discipline by maintaining orderly and clean production environments. However, the present study extends previous research by empirically demonstrating that the contribution of Cleanliness to production performance is indirect. Rather than directly improving production outcomes, Cleanliness strengthens Implementation Consistency, which subsequently enhances production performance. This finding reinforces the proposed structural model by confirming that workplace cleanliness is an integral component of a systematic operational management process rather than merely a housekeeping activity.

Implementation Consistency to Production Performance

Production Performance in this study is defined as the achievement of planned product quality, production quantity, and reject reduction targets. The hypothesis testing results indicate that Implementation Consistency has a positive and significant effect on Production Performance, confirming that the consistent execution of standardized operational procedures directly improves manufacturing outcomes. This finding demonstrates that the benefits of Preparation, Discipline, Compactness, and Cleanliness are realized through their ability to establish consistent implementation of production activities.

In the investigated bentonite plant, Implementation Consistency is reflected in employees' adherence to standardized operating procedures, consistent segregation of rejected products, and production processes that follow established operational guidelines. These practices reduce process variability, minimize production errors, and prevent product contamination, thereby improving product conformity while reducing rework and production losses. Consequently, production targets can be achieved more consistently in terms of both quality and quantity.

This finding is consistent with Monnanyana & Gupta (2021), who reported that the implementation of 5S significantly improved workplace organization, visibility, accessibility of tools and materials, and overall operational effectiveness. Similarly, Purwanto & Hartono (2022) found that consistent implementation of production planning and operational control positively influences manufacturing performance by improving production reliability and reducing operational inefficiencies. Therefore, the present study extends previous findings by demonstrating that Implementation Consistency acts as the key mechanism through which workplace management practices are translated into improved production performance within a bentonite manufacturing environment.

From a managerial perspective, the results suggest that maintaining Implementation Consistency should become a strategic priority. In addition to strengthening employee discipline, management should continuously monitor compliance with standard operating procedures, regularly evaluate production records and quality inspection results, and immediately investigate deviations in product quality, production quantity, or reject levels. Such continuous monitoring enables corrective actions to be implemented promptly, thereby sustaining production effectiveness and supporting continuous operational improvement.

CONCLUSION

This study demonstrates that the proposed customized production performance model provides a valid explanation of how operational management practices enhance production effectiveness in a bentonite manufacturing plant. Preparation serves as the fundamental construct that significantly influences Discipline, Compactness, and Cleanliness, which subsequently strengthen Implementation Consistency and ultimately improve Production Performance. These findings extend the conventional 5S framework by empirically validating the sequential relationships among its operational dimensions rather than treating 5S as a single integrated management practice.

The study contributes to the operational management literature by providing a structured and empirically validated model that explains how preparation and consistent workplace practices collectively improve production quality, production quantity, and reject reduction. From a practical perspective, manufacturing managers should prioritize strengthening preparation activities through employee competency development, standardized operating procedures, and clearly defined production specifications before implementing workplace organization initiatives. These activities establish the foundation for sustainable operational consistency and enhanced production performance.

Nevertheless, this study is limited by its cross-sectional research design and its focus on a single bentonite manufacturing plant, which may restrict the generalizability of the findings to other manufacturing environments. In addition, all constructs were measured using self-reported questionnaire responses from the same group of respondents, potentially introducing common method bias. Furthermore, the variance-based Partial Least Squares Structural Equation Modeling (PLS-SEM) approach supports the identification of statistical relationships among constructs but does not provide definitive evidence of causal relationships. Future studies are therefore encouraged to validate the proposed model across various manufacturing sectors by employing longitudinal research designs, objective operational performance indicators, and multi-plant datasets to improve the robustness, external validity, and generalizability of the findings.

ACKNOWLEDGEMENT

The authors would like to express their sincere appreciation to the management and employees of the bentonite manufacturing plant for their valuable cooperation, participation, and support throughout the data collection process. The authors also acknowledge Universitas Mercu Buana for providing academic support during the completion of this research.

AUTHOR CONTRIBUTION STATEMENT

All authors jointly contributed to the conception and design of the study, data collection, data analysis, interpretation of the findings, manuscript preparation, critical revision of the manuscript, and approval of the final version for publication. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Alves, J. R. X., & Alves, J. M. (2015). Production management model integrating the principles of lean manufacturing and sustainability supported by the cultural transformation of a company. *International Journal of Production Research*, *53*(17). https://doi.org/10.1080/00207543.2015.1033032

Daraei, R. M., Mirza Hasan, H., Iman, N., & Alireza, K. (2015). Identifying and Ranking the Critical Success Factors Affecting Implementation of 5S. *American Journal of Service Science and Management*, *2*(6).

Goshime, Y., Kitaw, D., & Jilcha, K. (2019). Lean manufacturing as a vehicle for improving productivity and customer satisfaction: A literature review on metals and engineering industries. *International Journal of Lean Six Sigma*, *10*(2). https://doi.org/10.1108/IJLSS-06-2017-0063

Gupta, S., & Jain, S. K. (2015). An application of 5S concept to organize the workplace at a scientific instruments manufacturing company. *International Journal of Lean Six Sigma*, *6*(1). https://doi.org/10.1108/IJLSS-08-2013-0047

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, *31*(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203.

Halim, I., & Srinivasan, R. (2006). Systematic waste minimization in chemical processes. 3. Batch operations. *Industrial and Engineering Chemistry Research*, *45*(13). https://doi.org/10.1021/ie050792b

Hartnett, J. L., Kropp, D. H., & Suzaki, K. (1988). The New Manufacturing Challenge: Techniques for Continuous Improvement. *The Academy of Management Review*, *13*(3). https://doi.org/10.2307/258098

Michalska, J., & Szewieczek, D. (2007). The 5S methodology as a tool for improving the organisation. *Journal of Achievements in Materials and Manufacturing Engineering*, *24*(2).

Monnanyana, O., & Gupta, K. (2021). A Case Study on Implementation of 5S in a Manufacturing Plant to Improve Operational Effectiveness. *MATEC Web of Conferences*, *346*. https://doi.org/10.1051/matecconf/202134603109

Nikolopoulou, A., & Ierapetritou, M. G. (2012). Optimal design of sustainable chemical processes and supply chains: A review. In *Computers and Chemical Engineering* (Vol. 44). https://doi.org/10.1016/j.compchemeng.2012.05.006

Omogbai, O., & Salonitis, K. (2017). The Implementation of 5S Lean Tool Using System Dynamics Approach. *Procedia CIRP*, *60*. https://doi.org/10.1016/j.procir.2017.01.057

Purwanto, A. H. D., & Hartono, S. (2022). Project Performance Through an Occupational and Health Safety Management System at an Office Building Project in Lampung Indonesia. *Jurnal Manajemen Teknologi*, *21*(2). https://doi.org/10.12695/jmt.2022.21.2.4

Purwanto, A. H. D., Nashar, M., Jumaryadi, Y., Wibowo, W., & Mekaniwati, A. (2022). Improving medium small micro enterprise' (MSME) performance. *International Journal of Advanced and Applied Sciences*, *9*(5). https://doi.org/10.21833/IJAAS.2022.05.005

Ramlawati, R., Management, A. K.-I. R. of, & 2018, U. (2018). Total Quality Management as the Key of the Company to Gain the Competitiveness, Performance Achievement and Consumer Satisfaction. *Researchgate.Net*, *8*(4).

Sabah, A., Al-Kindi, L., & Al-Baldawi, Z. (2023). Adopting Value Stream Mapping as a Lean Tool to Improve Production Performance. *Engineering and Technology Journal*, *41*(6). https://doi.org/10.30684/etj.2023.136269.1307

Sarwono, J., & Narimawati, U. (2015). Membuat Skripsi, Tesis, dan Disertasi dengan Partial Least Square SEM (PLS-SEM). *Academia*.

Schmenner, R. W., & Swink, M. L. (1998). On theory in operations management. *Journal of Operations Management*, *17*(1). https://doi.org/10.1016/S0272-6963(98)00028-X

Stoessel, F. (2020). Thermal Safety of Chemical Processes: Risk Assessment and Process Design. In *Thermal Safety of Chemical Processes: Risk Assessment and Process Design*. https://doi.org/10.1002/9783527696918

Suseno, B. D., Sugianto, E., Purnamasari, E., & Supriadi, A. (2023). Analysis of the Application of Operational Management in Manufacturing Companies in Bandung City: The Effect of Production Efficiency, Product Innovation, and Customer Satisfaction on Financial Performance. *West Science Journal Economic and Entrepreneurship*, *1*(11). https://doi.org/10.58812/wsjee.v1i11.354

Triana, N. E., & Lesmana, S. A. (2020). Application of Lean Manufacturing to Optimize Working Space by Reducing Lead Time in the Production Department Using the Value Stream Mapping (VSM) Method. *International Journal of Engineering Research and Advanced Technology*, *06*(07). https://doi.org/10.31695/ijerat.2020.3622

.